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## POST-WAR FOREST POLICY IN GREAT BRITAIN

OF the making of plans there is no end, but the White Paper on Post-War Forest Policy* deserves study for a number of reasons. It is of intrinsic national importance; it will affect the pattern of the countryside of Great Britain, particularly in those regions where the landscape is not dominated by hedgerow and wayside trees; while the proposals constitute an interesting example of the development of an industry directed and to a considerable extent financed by the State, but making provision for private enterprise. Moreover, the White Paper gives a summary of the work of the Forestry Commission since it was set up in 1919. It is clear that, within the limitations of policy and finance imposed on it, it has done good work and deserves appreciation from the public.

It is important that Great Britain should have a sound forest policy. First, the two world wars have demonstrated beyond doubt that an adequate reserve of standing timber is a national necessity. Although the available supplies were not large, and to meet the emergency it has been necessary to devastate and disorganize this country's forest resources to a much greater extent than in other belligerent countries, the ability to expand the peace-time home timber production many times over has meant the saving of millions of tons of shipping in both wars, and in both shipping has been vital to victory. The development of air power will only underline this experience. Secondly, there is evidence that the British people are beginning to realize that the full use of land resources is the basis of sustained prosperity. Forestry is one of the necessary uses of land, and a sound forest policy will enable forestry to be integrated with agriculture and other land uses. Thirdly, there is much land in Great Britain suitable for the growing of the kinds of timber we need—mainly softwoods—and from an economic point of view better so used. Fourthly, the British people have great forest responsibilities throughout the Commonwealth, and this, the heart and centre, should give a lead in the proper organization and use of forest resources, both actual and potential.

A sound forest policy for Great Britain must meet certain requirements. It must provide adequate resources in the shortest possible time; it must be wide enough to bring all the benefits which forestry can give to rural development in its widest sense; continuity of aim and effort must be provided for; State and private efforts must be integrated, and provision made for the development of both; an efficient home timber industry to utilize the resources must be maintained and developed; provision must be made for the building up of the necessary scientific and technical knowledge and experience to carry out the policy, and this calls for a vigorous research policy and adequate education of personnel; and lastly, the type and design of the forest authority must

* Post-War Forest Policy. Report by H.M. Forestry Commissioners. (Cmd. 6447.) Pp. 114. (London: H.M. Stationery Office.) 2s. net.

be that best fitted for the fulfilment of its tasks. The proposals of the White Paper will be considered in the light of these requirements.

The Report states that the forest area of Britain is about three million acres, or 5·5 per cent of the land area. This is one of the lowest percentages of any country in Europe, and moreover, a considerable part of it has been cut over for war purposes. Other industrialized countries have a much larger percentage under woodland; for example, Belgium 18·4 per cent and Holland 7·8 per cent. The White Paper proposes that a forest area of five million acres be built up in a period of fifty years, made up as to two million acres selected as the most suitable from the existing three million acres, and three million acres of new afforestation. It would appear that this area could be withdrawn from rough grazings over a period without seriously reducing food production. When this has been attained, about 9 per cent of the land area would be under forest, and the timber produced therefrom would ultimately provide about 35 per cent of our present consumption. From the information given, this is the minimum necessary to enable abnormal overcutting in an emergency of three or four years without serious and long-term disorganization of the forest resources, while from a peace-time point of view it does not aim at uneconomic self-sufficiency. It can only be considered adequate under intensive management. It is emphasized that planting alone is not enough, but that subsequent care and tending are essential. The policy to be followed in forest management is not discussed in much detail, although this is an important matter.

The proposals envisage that, during the first decade, 1,100,000 acres would be replanted or planted at a net cost of £41·2 million. This is called the "desirable" programme. An "intermediate" programme of 875,000 acres costing £32 million is also given. If the financial resources and trained personnel are available to carry out efficiently the "desirable" programme, it appears to be more in accord with the needs of the country. The estimated average annual cost of the "desirable" programme during the first decade would amount to less than 7 per cent of the cost of timber imports into Great Britain in an average peace-time year.

The White Paper rightly stresses the timber production aspect of forest policy, but it also deals with rural settlement, employment, and the recreational aspect through the medium of National Forest Parks. The amenity aspect is mentioned. It is noted, however, that smaller woods, and in particular shelter belts, are excluded from the dedication proposals to be referred to later. In certain upland parts of Great Britain there is need for the rehabilitation and extension of shelter belts in the interests of the pastoral industry, and this should be provided in the forest policy, although the work would have to be carried out in consultation with agricultural interests. Land put to productive uses has a beauty of its own, and the amenity value of woods should not be judged from their early stages; but within the limitations imposed by the timber needs of Britain, every effort should be made, both in the pattern of the forests and the species used, to ensure that they accord with the varying structure of our countryside.

The proposals are a long-term plan of investment by the State, the fruits, financial and otherwise, to be gathered in due season. The provision for its carrying out will depend on Parliament and ultimately on public opinion. Means should therefore be taken to ensure that the public is fully informed of the progress of the work by controlled access to forest areas, through the Press, publications, radio and cinema. Adequate publicity is essential for continuity.

The forest policy enunciated by the Acland Committee, which has been the basis of the work of the Forestry Commission since its inception, was impaired by two happenings. First, the Government reduced its grants in two periods of trade depression, while the part allotted by the Committee to private forestry was greater than could be undertaken in the economic and social circumstances prevailing, and no provision was made for the State to make good the deficiency. As regards the first point, it is to be hoped that future Chancellors of the Exchequer and chairmen of economy committees will appreciate that in periods of trade depression, capital investment by the State should be increased and not decreased, while the defect in the previous policy is removed in the present proposals.

It should be emphasized that practically all the timber which has been of such great value to Great Britain's effort in this War and that of 1914–18 was grown by private owners, and that our woodlands are still predominantly privately owned. Moreover, private foresters have, in the past, made important contributions to technical advancement. Britain was the pioneer in the introduction and trial of tree species from all over the world. This was done wholly by private enterprise, and the example and the results have been of great value to forestry development, not only here but also throughout the world. Further, many of the most important technical developments both in Britain and elsewhere have been made by private foresters. Unfortunately, the health and vigour of private forestry has declined, particularly since the War of 1914–18. The causes and their cure are mainly national and not forest, namely, the effects of taxation on rural properties and a feeling of insecurity which particularly affects forestry; but the forest policy should aim, so far as it can, at the resuscitation of private forestry, because it is capable of making our forestry a richer and more varied thing than it would otherwise be.

The White Paper proposes a scheme whereby private owners would 'dedicate' woods. This would involve an undertaking to use the land so that timber production would be the main object, to manage according to an approved plan, to employ skilled supervision, and to keep adequate accounts. In return for this and also for the continuance of the war-time control of fellings, the State would pay 25 per cent of the net annual expenditure when there was a deficiency, and provide private loans at current rates of interest. The scheme provides that all suitable forest land should be dedicated or in due course

taken over by the State, land not properly used being dealt with first. The needs of the country necessitate that all suitable forest land be used for timber production. To discuss whether the terms offered are the best and most generous which should be made is outside the scope of this article; it will be in the national interest, however, if it is made possible for owners interested in forestry, small and large, to play their part in forestry development in Great Britain. The task is so large that all who can help are needed, and private enterprise can make a distinctive contribution.

One of the tragedies of the present abnormal overcutting is that the future of the home timber industry is gravely jeopardized. Nevertheless, it is useless to create forest resources without providing for their logging and conversion. The problem is referred to in the White Paper, and it is stated that consultations are proceeding. It is one of great difficulty, but means must be found to conserve and develop the available skill and knowledge of the industry's personnel in such a way that the industry can be readily expanded as increased timber supplies become available in the future.

To fulfil the tasks envisaged by the White Paper will call for personnel in all grades who have the requisite imagination, love of the countryside, scientific background and technical training, and who will have available to them the results of a well-conceived and vigorous research policy.

On the educational side it is important that the right kind of men be attracted and proper provision made for their training, which should not be on too narrow a technical basis in the case of the higher grades. When recruited, they should be encouraged by reasonable conditions of service, and leaders developed by devolution of authority according to capacity. No concrete educational proposals are made in the Report, but these are promised later; it is important that they be adequate.

The outstanding research problems are discussed. There is emphasis on technical problems rather than on the broad scientific fields on which these technical problems rest. It is probable that the development of private forestry will call for research in the economic field of forestry, but no reference to such is made. The principal new proposal in research organization is the creation of a forest research station at Alice Holt. This will involve the withdrawal of the Commission's research workers from universities. The creation of field research stations, suitably equipped, is to be welcomed, and all the principal forest regions of Britain should ultimately be covered, but such centres must be irrigated by streams of thought and ideas from the sciences and arts on which forestry is based. The universities are, or should be, the centres of such inspiration, and such forest research centres should be regarded as seasonal centres only, the research workers being based on universities. This proposal in the White Paper should be reconsidered.

In the provisional estimate of expenditure for the first decade, the allocation for education and research is less than 1½ per cent of the total expenditure. This is certainly not excessive.

The design of the forest authority should, on one hand, promote the efficient and vigorous carrying out of the forest policy, and, on the other, secure adequate contact with Parliament, the source of its funds, and the other departments of State concerned with rural planning and development. The latter will be more important in the future than in the past. A greater area of land will be drawn from other uses, and it appears likely that the countryside of Britain will be more consciously planned as a whole in future.

The White Paper does not propose any important changes in the present constitution of the Forestry Commission. An *ad hoc* authority independent of the Agricultural Departments is proposed. Experience indicates that this is essential to secure vigorous forestry development, but machinery will be necessary for co-ordination with other interested departments and bodies to ensure the integration of rural development as a whole. A single authority for the whole country is also proposed. As agriculture and planning in Scotland is under the Secretary of State, the question of a separate authority for Scotland has been raised. On balance, the advantages of a single unified service are substantial, but it is clear that there should be wide devolution of authority, both in the interests of forestry development itself, and to ensure adequate integration with the agricultural and other departments. The greater the effective devolution, the more certainly will forestry development accord with regional characteristics, physical, social and economic.

The Forestry Commission differs from the usual Government Department in design. It has certain advantages, but one of the drawbacks is that it has no ministerial spokesman, being represented in Parliament by one of its members. While not recommending it, the White Paper suggests that in future it might be represented by the Lord President of the Council, assisted by a committee consisting of the Secretary of State for Scotland, the Minister of Agriculture and the chairman of the Forestry Commission. It may be suggested that the Minister of Town and Country Planning should also be included. Whether this proposal is the best to ensure that forestry is suitably represented in Parliament, and secure, with other means, adequate co-ordination with other interested departments, is a matter for careful consideration before a decision is made.

## EDUCATION FOR WORLD CITIZENSHIP

### Social Studies and World Citizenship

A Sociological Approach to Education. By L. J. F. Brimble and Frederick J. May. Pp. xii+158. (London: Macmillan and Co., Ltd., 1943.) 6s. net.

IF civilization is to survive, a super-national organization will have to be set up in order to restrain the ambition and moderate the selfishness of competing national States. We can no longer afford political anarchy: the world is too small, industry too complex, science too powerful. Our experience

with the League of Nations, however, has taught us that the problem is not to be solved merely at the organizational or institutional level. Federations, leagues, world governments will not function unless there exists a public opinion capable of sustaining and animating them.

The formation of the attitudes and mental patterns appropriate to the political organization of the modern world is obviously an educational problem. Rightly directed, the schools could solve it in one generation, but, unfortunately, the obstacles in the way are immense. For education is nowhere looked upon as a revolutionary instrument. On the contrary, it is everywhere closely harnessed to national purposes and its chief task is that of conservation—of guaranteeing cohesion and unity in society.

Yet, even within the existing framework, far more could be done than is done to foster in young people the qualities needed to make them good citizens of the world. Indeed, teachers of vision already do much to inspire in their pupils loyalties which transcend frontiers. It is urgently necessary that their experience be spread wide. In addition, many difficult questions remain to be discussed and explored.

Mr. Brimble and Mr. May intend their book—the first of its kind to be published in England—as a contribution to such discussion rather than as an authoritative and definitive pronouncement. It is not, perhaps, a brilliant, highly finished and polished book—indeed there are many evidences of hasty composition—but it is cheerful, readable and highly provocative. The authors deserve our gratitude for having done a modest job so well and for completing it at so appropriate a moment.

Among the early chapters are "World Citizenship" and "World Democracy". In them, the authors describe the numerous existing international organizations—economic, scientific, medical, financial, religious, etc.—which represent the organs of the embryonic World State. They briefly discuss, too, what is meant by the democratic way of life. To them, democracy involves social and economic duties and they see in it a dynamic which, of necessity, makes it super-national in character: social justice can be attained and maintained at home only if its benefits are made universal. The whole world must be safe for democracy if it is to be safe anywhere: isolationism is its enemy.

Having discussed the application of these ideas to education in general, the authors devote a series of chapters to a closer consideration of what they imply for the teaching of each of the major subject areas in the curriculum of schools—natural sciences, history, geography, etc. They believe that the new spirit "will not show itself by the addition or deletion of this or that subject, but rather will it be evident in the angle of approach and the method of presentation of subjects already in the curriculum". Since the democratic ideals are super-national, they think that the kind of teaching which turns out good democratic citizens of Britain will, of necessity, help to produce good citizens of the world.

This belief leads them to devote much attention to the kind of work best described as "Education for Democracy". They hope that civics will be taught, so that citizens will understand better than they do at present the structure of the government for whose actions they bear responsibility; they suggest that world history be included in the curriculum, so that young people may learn to rise above the love of their own nation to the vision of a developing world community; they recommend that the literary diet include samples (in translation) of the great classics of other lands and that its content be chosen so as not to stress ideals (for example, love and admiration of war and strife) which are inimical to democratic world fellowship; they stress the importance of teaching natural science with due regard to its social applications, so that young people will see in science a major agent of social change and become used to thinking of it in terms of human welfare.

The authors have certainly collected a great store of useful advice which teachers would do well to study. Their book is a mine of practical suggestions, all of which could be applied. To do as they say would greatly increase the efficacy of the work being done and make teaching more vital and significant. At the same time, the book is not free from ambiguities and even contradictions. A scientific reader, for example, may be somewhat perturbed to see so much attention paid to religious education: "The whole of our youth training", say the authors, "should have a religious as opposed to an agnostic background". One's disquiet is not entirely assuaged by the next sentence: "But such training must be based on rational observation and not on emotional feelings and mythical beliefs". It should not be forgotten that (in the words of Prof. J. K. Hart, quoted in the book) though "primitively religion stood for the wholeness of the group, now it often stands for the fractionating of the community, the group and even the individual". In addition, religious feelings are often associated with an attitude of complacent superiority towards men of other faiths, which is not the best foundation for real fellowship. Some of our more religiously minded politicians have not been entirely free from this defect in their public utterances.

One should also note that the theoretical parts of the book are, in general, weak and unsatisfactory. Often the authors approach really difficult and interesting problems and then sheer off. They talk about bias and propaganda, but content themselves by saying it can be avoided. They devote a chapter to "Sex Guidance as a Social Discipline", but do not go beyond giving the ordinary advice with little attempt at fundamental interpretation or at a discussion of the psycho-analytic approach to the problems of aggressiveness and war. They do not consider the obstacles which exist to that proper ordering of our internal affairs and that reshaping of our economic and social order which is the necessary preliminary to the establishment of a world society. There is no detailed discussion of the kind of education required to diminish tension and resolve conflicts of a racial, religious or ideological kind.

It would have been well, too, if more careful attention had been paid to American experience and research. The problem tackled in the United States is in some ways not unlike that which faces us in Europe: how to teach persons belonging to different racial, religious and linguistic groups to live together without fighting. Lastly, it would have been useful to list and to state clearly questions and problems susceptible to objective and scientific treatment.

On one major point, I must join issue with the authors. They urge the imperative necessity of selecting and teaching everywhere an auxiliary world-language. Scientific men do not need to be convinced about this: 'Babel' has indeed become a curse instead of merely a major nuisance, and 'debabelization' must be attempted. But the authors opt for Esperanto, which, in my opinion, has very

little to recommend it; its close attachment to European roots and forms militates against its universal extension. Its defects are such that after sixty years of active and ingenious propaganda, very few people can use it.

In fact, there are two—and only two—possible world auxiliary languages. The first is Basic English. The other is Lancelot Hogben's *Interglossa*, which is even more rational and scientific than Basic, and is so simple that it can be learned by an intelligent person in one or two days. It has all the advantages of Esperanto and few of its greater defects.

These criticisms will not, I hope, keep people from reading the book: they are to be taken as an index of vigorous interest and of stimulation. The authors have tackled an original subject and have attempted to pioneer: the proof of their success is found in the amount of praise they arouse rather than in the amount of agreement they receive. How forward-looking and progressive they are can be appreciated only when their book is compared with, say, the Norwood Report on "Curriculum and Examinations in Secondary Schools". This is a dull, turgid and backward-looking document, but it represents, alas, an attitude widespread among persons who have much influence on our educational system. The Norwood Committee has little faith in "Civics", little use for "Social Studies", little interest in "Education for Democracy". It believes that the aims of education must be transcendent and has little hope that guidance can be got from "the provisional findings of the special sciences, whether biological, psychological, or sociological". So far as one can find out from its involved and rather muddy statements, it is even doubtful whether that Committee would agree with Brimble and May's fundamental assumption, which is that the major function of education is to promote the welfare of mankind.

It is against a background of this kind that "Social Studies and World Citizenship" is to be judged if its true value and worth is to be properly appreciated. One hopes it will have the success it deserves, and that it will serve to initiate the fundamental discussion which is so badly needed. J. A. LAUWERYS.

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## THE RISING TIDE OF SCIENCE

### Forward with Science

By Prof. Rogers D. Rusk. Pp. xiv+308+v+24 plates. (New York: Alfred A. Knopf, 1943). 3·50 dollars.

THE impact of science upon society has, as all readers of NATURE will know, already been the subject of much discussion. On one hand there is the optimistic school of thought which prophesies that, if only we employ sufficient men of science and technologists and give them the position of authority in the State to which their indubitable talents entitle them, we shall find ourselves entering into an age of plenty. On the other hand there is a growing, though less vocal, apprehension that for all these good things there may be a price to be paid, and that vigilance will have to be exercised to ensure that moral and spiritual values which are vital to the welfare of mankind are not submerged in the rising tide. The possibilities and the dangers are obviously far more than national in scope, and it was not without interest that one approached this treatment of the theme from across the Atlantic.

"The present volume", so the preface tells us, "aims to fill a definite need in making recent developments in science understandable and meaningful. It was begun in the pattern of a previous volume which treated of modern achievements in physical science and their relation to human life, but with the rising tide of social revolution there emerged even more clearly the urgent need to show where possible what recent developments are of the greatest human significance to-day and how the wave of science is related to the present engulfing social tide." This is a considerable programme for a volume of little more than three hundred pages, two thirds of which are occupied with brief but quite excellent accounts of the latest developments of physics in its 'purest' and most theoretical aspects. It is obvious that, in so brief a space there can be no adequate discussion of the problems raised and, indeed, Dr. Rusk is not arguing; he is telling us. Nevertheless it is good to have both the possible benefits and the inherent dangers of this sudden uprush of scientific achievement into a morally unprepared world so objectively and so honestly set out, as they are in this volume.

Dr. Rusk is not only a physicist but also a student of philosophy (there is, perhaps, just a trace of professional condescension in his dismissal of the philosophical speculations of Eddington and Compton), and takes a rather wider view than the sheer laboratory mind, which is apt to be a little dazzled by the brilliance of its own achievements. "The wave of scientific and technical development upon which the world has been rushing forward", he writes, "represents both a glorious accomplishment and a grave threat. It embodies the utmost in promise for the future happiness, comfort and intellectual achievement of mankind, while at the same time it also threatens the most serious consequences of misuse, leading even to destruction and death." On one hand, "It is not a government committee or a government fund of gold in Washington that can guarantee security in old age and sickness and financial depression; it is science with its potentialities for production . . .". On the other hand, technology has placed enormous power in the hands of a few, partly by the means which it affords for conditioning the mass mind of a nation, and partly by the ease with which the few, armed with modern weapons, can hold down the many. "The unholy alliance between war and science which has made modern warfare possible has intensified the capacity of a dictatorship to make men fight, and the incapacity of a democracy, for no longer can a million effective men spring up overnight."

Further, in the opinion of the author the wave of science has precipitated, or at any rate coincided with, a revolutionary social movement. "The great masses of mankind from the farms of Kansas to the flats of New Jersey and from the steppes of Russia to the mountains of China are beginning to recognize the potentialities of the technical age in which they live and the fact that they have a right to help shape their own future." . . . "No longer can one expect to set up a beneficent static State such as Plato's Republic, and no longer can we expect the unmodified truths of Malthus or Marx to enable us to achieve a final satisfactory static state." In fact Dr. Rusk seems to think that stability is no longer a possibility.

To steer society safely through the uncharted rocks ahead and to justify his optimism (for the book, as

its title "Forward with Science" implies, is on the whole optimistic) Dr. Rusk looks to the spread of scientific education among the masses, and to an evolution from within science itself of some moral sense to replace the religious idea of 'sin'. He also cherishes the belief that there is some esoteric relation between science and democracy. In fact he repeats this theme so often that one wonders whether he is not practising a form of Coué-ism, and hopes by saying it often enough to make it come true; especially as he shows himself fully aware of the fact that, however it may be with science, her half-sister technology sits openly in the market-place ready to bestow her favours on anyone who is prepared to make a bid for them. "Science", he concludes, "is a self-perpetuating movement which can scarcely be stopped. In totalitarian states it has been controlled for purposes of military aggression, and in democratic nations it has risen up in its might to combat totalitarianism. But a controlled science is not a free science, and the essence of science is to be free. Social planning may seek to control the impact on society, but it must not control the spirit of science. Indeed, a free science more than anything else can make social planning possible and workable. But this in turn implies a high technical and moral and social level, and such a level cannot be attained through soft living or soft education, of which there has been too much."

"Forward with Science" is not a great book—one would scarcely rank it higher than first-class journalism—but it is a thoroughly honest attempt by a physicist who has read widely, thought seriously and who has more than average skill in putting his ideas clearly before the average reader, to deal with problems of urgent importance. As such it can be commended to the attention of the rapidly growing circle of readers who are becoming concerned about the impact of the tidal wave of science on the social structure. There is much in the book which deserves anxious thought.

Although, following the lead given by the author himself in his preface, we have dealt mainly with the sociological chapters in the book, it may be added that between them, like the jam in a sandwich, there are some very well-written accounts of the very latest developments in atomic and theoretical physics. Dr. Rusk is unusually successful to conveying to the lay reader the essence of these outstanding achievements of modern science, without worrying him with details which would only confuse, without adding anything of real importance. We may add that the illustrations, with which the book is amply furnished, are the most pleasing we have seen for a long while.

In conclusion, there is one sentence in the preface which I hope Dr. Rusk will agree to modify in his second edition. It reads: "If the scientific and technical level of our nation is continually to rise, as it must *if we are to retain world leadership*, the achievements of science cannot remain only for the cloistered few." The words in italics are, of course, common form, and could easily be paralleled from articles and reports in Great Britain and no doubt in Germany, the U.S.S.R. and elsewhere, but has not the time arrived when men of science, at any rate, might come to regard their work not as part of an international struggle for world leadership but rather as a common service for the good of humanity as a whole? If not, the outlook for society is indeed bleak. I feel sure that Dr. Rusk will agree.

J. A. CROWTHER.

# ABSORPTION SPECTRA IN MEDICINE

## Spectrophotometry in Medicine

Being the authorised translation of "Medizinische Spektrophotometrie" by Dr. Ludwig Heilmeyer. Translated by Dr. A. Jordan and T. L. Tippell. Pp. xiv +280. (London: Adam Hilger, Ltd., 1943.) 30*s*. net.

THE German edition of this work was published in 1933 by G. Fischer of Jena. The author, working at the Laboratory of Clinical Medicine at the University of Jena, had by then made substantial use of modern methods of spectrophotometry for investigating body fluids, and at the outbreak of the War was still publishing valuable work in this field. His book received scant attention in British and American journals, but as the subject-matter grew in interest and significance and a knowledge of spectrophotometric technique became more widespread, the need was felt for a translation. The book was naturally somewhat out of date in 1939 and it cannot be doubted that, but for the War, Heilmeyer would have desired to revise some of the chapters rather drastically for the English edition.

The translators were faced with a difficult problem. The symbols in use in spectrophotometry have now been agreed upon and differ from those used in the German original, and the newer ones have been used throughout the translation. The description of spectrophotometric technique has been discreetly brought up to date, and here and there useful footnotes on recent work have been added. The work as a whole, however, remains as it was written and the very careful translation deals faithfully even with some obscure passages.

It is necessary to emphasize that clinicians and research workers using this book will need to search the literature of the last ten years for themselves.

The work consists of six parts. The first deals with the theory and technique of spectrophotometry and is excellent. The second is concerned with absorption spectra applied to blood and hæmoglobin derivatives, and provides a very convenient summary of a difficult field. Part 3 covers the first breakdown products of hæmoglobin, and is a section which will need much revision and amplification in the light of recent work. The fourth part deals with blood serum and both normal and pathological serum pigments. Bilirubin and synthetic bilirubinoid pigments, as well as the lipochrome pigments, are reviewed, but there is no mention of vitamin A, concerning the determination of which in sera there is now a considerable literature. The next part discusses the spectrophotometry of urine, urobilin, urobilinogen and uroerythrin, together with urochromes A and B. Hæmoglobinuria and porphyrinuria are considered as fully as the state of knowledge in 1932 justified. There is finally a short section on bile, ascitic fluid and cerebrospinal fluid. The translation is ably and copiously indexed.

The chief virtue of Heilmeyer's book is that it unites a thorough knowledge of spectrophotometry with the systematic study of pathological material available in a university clinical laboratory. In this respect it is unique and indispensable. It shows convincingly how much has been achieved in the field, and it is greatly to be hoped that this translation will prepare the way for a new edition after the War. In the meantime the present issue can do much to promote co-operation between spectroscopists and pathologists.

R. A. MORTON.

# SCIENCE IN WESTERN SZECHUAN

## I. PHYSICO-CHEMICAL SCIENCES AND TECHNOLOGY

By DR. JOSEPH NEEDHAM, F.R.S.

British Scientific Mission in China

IN the foregoing articles of this series* the attempt has been made to report to Western scientific men something of the remarkable efforts of their Chinese colleagues in a pre-industrial hinterland lacking all modern resources. The attempt is here continued with respect to the western parts of the province of Szechuan, lying between the Tibetan borderlands to the east and the Yangtze valley in Hubeh to the west.

The principal city of western Szechuan is Chengtu. When Chinese jokingly discuss which city of Free China represents the lost cities of eastern China, Chengtu is always analogized with Peiping; and it does indeed have the air of ancient city culture. It covers a very large area, much of the city wall still stands, and it is rich in old bookshops. It might remind the English visitor of York (for some of the Buddhist abbeys are reminiscent of any cathedral close) if it were not so flat, with willow-fringed canals not unlike those of the Cambridge fens. Chengtu has for many years been the home of the ('missionary') West China Union (Huahsi) University, the buildings of which, erected in semi-Chinese style on an admirable campus, are now by far the best of any university in Free China. This University has very hospitably accepted no fewer than four other universities (all originally 'missionary', now known as 'private', as opposed to State, or national, universities) as evacuees, namely, Chilu University from Shantung, Yenching University from Peiping, Nanking University from Nanking, and Ginling Women's College (the Chinese counterpart of Girton College, Cambridge), also from Nanking. The total number of students is to-day somewhat more than 3,000, of which two thirds are men and one third women. In general, it may be said that these private universities concentrate mainly on undergraduate teaching and less on the higher walks of research than some of the other Chinese universities, but the importance of a great centre of student life under comparatively good conditions of existence in these days should not be underestimated. Among the presidents of these institutions are some internationally known scholars, such as Dr. Mei Yi-Bao of Yenching, the translator of the philosopher Mo-Tze, and Dr. Wu Yi-Fang of Ginling College.

A good deal of fusion of the scientific departments of these Universities has taken place in practice, though theoretically they are still distinct. In general, research interest is concentrated on practical problems of importance to the community. Thus the chemists of Huahsi University (Profs. Roy Spooner and Chang Chuan) direct investigations on the indigo and natural dyestuff industry of the province, on gelatin emulsions with reference to the production of X-ray plates, on the properties of Chinese soapnut saponins, on electroplating, and on tanning, for which there is an elaborate experimental plant established on the campus. Here all kinds of improvisations, under Dr. Chang's initiative, have had to be thought of; all the machinery is made of local woods, and when emery wheels cannot be had, one imitates them by setting broken glass in a medium of tung oil. In Chilu University, Prof. Hsieh Yu is interested primarily in the active principles of indigenous drugs, especially anti-malarials. In Ginling University, Prof. Tai An-Bang, a colloid chemist, supervises work on soy-bean globulins (important for the production of 'casein' glue), copper insecticides, and tung oil polymerization. It will be seen that here, as much as, if not more than, in any other Chinese universities visited, research on immediate war problems is going on, just as in Britain. But the burden of teaching weighs heavily on the staffs of these Universities, and until it is lifted attainment of a high level of research can scarcely be expected. One of the most outstanding scientific men at Chengtu is probably Dr. Li Fang-Hsun, the physical chemist of Ginling University, whose work on ionic entropies, ionic volumes, hydration, etc., is widely known. So also is the work of Dr. Li Hen, the mathematician and astronomer of Huahsi University, a member of the National Academy.

One of Dr. Li Fang-Hsun's colleagues, Dean Wei Shich-Rjeng, an extremely capable organizer, has collaborated with the progressive director of education of Szechuan province, Commissioner Kuo Yo-Shou, in setting up a factory for producing school and simple laboratory apparatus. This goes out to eleven other provinces as well, and includes good chemical balances weighing to 1/5 mgm. and all imaginable physical and chemical apparatus and chemical reagents. The plant includes a glass factory. To illustrate the primitive conditions which must often be overcome, it was remarkable to see a dynamo for providing a low-voltage electric current for electroplating operated by hand, as no main current is available in this region outside the city. Mention may also be made at this point of a Popular Science Hall, planned along the lines of the Science Museum at South Kensington, but only just installed in some buildings of an old temple. It was pleasant to see in the garden stone models of the principal figures in solid geometry, with inscriptions in Chinese assiduously studied in the shade of the trees by small Chinese boy scouts.

The best applied physics and chemistry in Chengtu is probably going on in the experimental establishments of the Chinese Air Force Research Bureau, directed by Colonel Wang Tzu, but details cannot be given here for security reasons.

Turning now to a few words on the technology of the region, which is exceptionally interesting, China has in the Tzuliuching (lit. "Self-flowing Well") area an inspiration to her modern industrial chemists. For centuries back, so far that the memory of man runneth not to the contrary, there have been brine wells in this area, sunk by local methods using bamboo rope-suspended drills working for perhaps twenty years to complete one boring, and producing several sorts of brine, black, white and yellow. These brines are of different composition, and from them, by modern methods, partly in private factories, and partly in plants under the National Resources Commission, numerous important salts are separated (for example, salts of barium, boron, magnesium, lithium, strontium, bromine, etc.). Not many miles away, at Fivebridges, the Huanghai Industrial Research Institute (a privately supported organization on the same lines as the Mellon Institute at Pittsburgh, but in an entirely rural setting, ably directed by Dr. Sun Shioh-Wo and Dr. Chang Chien-Long) analyses these brines and works out new methods of separating their constituents.

*See NATURE, July 3, p. 9, July 10, p. 36, and July 17, p. 64, 1943.

The brine region is indeed nothing more nor less than an industrial area in the midst of a vast pre-industrial country and civilization. Needless it would be to point out the fundamental importance of such a source of salt in Central Asia so far from the sea-coast. The technique remains primitive to this day; a bamboo cable drops down the boring for two or three thousand feet and is wound up on a huge horizontal drum driven round by oxen. Steam and electric winding-gear is now, however, being introduced. But yet another circumstance is remarkable, namely, that the brine is associated with enormous amounts of natural gas, and one may see vast halls with hundreds of pans of evaporating brine each heated by a large burner connected with a boring. Still more extraordinary is the use of bamboo piping for conveying the brine from the wells to the factories over miles and miles of country. These bamboos are bound round outside with bamboo strips and cemented together with tung oil and lime; they stand a pressure of 80 lb. per sq. in. Unfortunately, bamboo will not do for water-supply in towns, as it is rotted by fresh water.

Such is ancient chemical technology in west China; the new has other features we must admire. Under the National Resources Commission, industrial plants have sprung up everywhere in Szechuan. In the sugar-producing area around Inwardstream (I garble-translate the place-names as usual), there are large works producing power alcohol from molasses for motor-vehicles; that directed by Dr. Chang Chi-Hsi is an example. Urea from human waste serves systematically here as nitrogen-source for culturing the yeast. Near Fivebridges there is an admirable low-temperature carbonization plant (the coal supply is difficult, seams being usually only 2 ft. thick over a wide area) directed by Dr. Huang Rjeng-Chi, and a wood dry-distillation plant directed by Dr. Gao Chang-Kung. Now the characteristic of all these plants is that they are usually built and operated by men of general chemical engineering training but without special experience, who went, as it were, into the wilderness and 'created' (the French idiom alone expresses it) the beginnings of industry, under the urge of war but with an eye to the peace. From the high lecture-hall of Wuhan University at Chiating, a lovely town at the junction of two great rivers tributary to the Yangtze, one sees in the far distance two things—a statue of Buddha 360 ft. high carved in the cliff, and on the other side a factory chimney. The social gospel of Confucian this-worldliness is conquering at last.

Wuhan University at Chiating, presided over by Dr. Wang Hsing-Kung, himself a chemical engineer, is housed partly in a beautiful Confucian temple, with its library occupying the shrine of the sage itself; but the physico-chemical departments are located in an old family temple with a charming loggia on the top of the city wall overlooking the river with the great Buddhist place of pilgrimage, Mount Omei, in the distance. Here Dr. Hu Chien-Shan (one of Prof. P. M. S. Blackett's most eminent collaborators) works and teaches; he has just completed a book in Chinese on cosmic rays. Head of the Chemistry Department is Dr. Wu Pao-Liang, the physical chemist, who has recently published an interesting work on omni-range electrical forces and static nuclei. He emphasized the isolation of scientific men in this remote spot in his need for up-to-date data on nuclear masses. The theoretical physicist is Dr. Chiang Rjeng-Shou (a former collaborator of Prof. E. N. da C. Andrade); he is directing the work of Liu Li-Ben on copper oxide rectifiers and that of Lo Wei-Kuang on the effect of temperature on elasticity in metals. In chemistry, Dr. Yeh Chiao investigates the active principles of indigenous drugs. While at Wuhan I had the pleasure of seeing a microfilm-reading machine arrive from International Cultural Service at Chungking (this deserves an article to itself) together with many microfilms. We got the machine working and the first films at which we looked were *Science* and *Journal of Nutrition* up to February 1943. The delight of these isolated men may easily be imagined. But nearly all the material so far coming in this way is from the American side, and on the British side we are only just belatedly beginning.

There is no doubt that at Wuhan University the scientific level is very high, comparing favourably even with the National Southwest Associated Universities at Kunming. Chiating, however, contains other institutions of some interest. We may mention the Polytechnic College, where courses are given in all branches of chemistry and engineering pertaining to light industry; for example, in agriculture, paper-making, textiles, leather and sericulture. The lonely location of all this region may be visualized by the remark made by the engineer of one of the National Resources Commission power stations, who said, as we stood at the door looking towards the Tibetan border mountains, "Remember that this is the last power plant until you come northwest to the Soviet Union across Central Asia six degrees of longitude west and three degrees north!"

Another academic institution of the first rank is Tongchi University, situated in the very small town of Appletree Rapids a hundred miles or so down the Yangtze. It was originally the German-Chinese University, and the atmosphere is still mainly German, though of course anti-Nazi. Its president is Dr. Ting Wen-Yuan, a younger brother of the famous geologist V. K. Ting. Its headquarters are in an extremely beautiful temple beside the river dedicated to Ta Yü, the legendary engineer who first established China's irrigation systems. Under the carved and gilded beams and roofs portraying the life of this great organizer and technologist, the students gather for special lectures or pass to and from their classrooms. I was privileged to be there on the annual day dedicated to Ta Yü's memory, and to address the students, after the usual ceremonies and a speech on the work of engineers in China by Dr. Ni Chao. Here at Tongchi the departments of physics and chemistry live but a struggling life, for as at Wuhan, their apparatus was much damaged by bombing and transportation from the east, but the engineering departments are flourishing. The University has its own power plant, and the students spend much time in assembling and erecting a large amount of plant brought up-river. There is United Nations collaboration here, for the professor of steel construction is a Pole. Particularly striking is the Department of Geodetics, Surveying and Cartography under the able Dr. Yeh Shwi-An, with excellent equipment; this has almost a monopoly of the production of Chinese surveyors and mapmakers.

The definitely religious veneration paid to the great irrigation engineer, Ta Yü, is of much interest. Some distance to the north-west of Chengtu there is a town called Kuanhsien, where may be seen what must be one of the most remarkable irrigation works of the world. A great river, the Min Chiang, issuing from the mountainous country of the Tibetan borderland,

is there diverted at certain seasons of the year by movable dams and spillways into an enormous cutting through a hillside, forming thereby an artificial river which fertilizes 500,000 acres of first-class agricultural land by means of 1,200 km. of irrigation channels. But the striking feature of the work is that it was begun in 250 B.C. by Li Bing, then governor of this province, and has been kept up ever since. Moreover, the Chinese were not content to regard such works from a purely utilitarian point of view. With their characteristic ability to raise the highest secular to the level of the numinous, they built upon the outermost spur of the hill through which the river cuts, a magnificent temple to Li Bing, and farther up, in a scarcely less beautiful situation, a wooded hillside next the river, another one to his son, also an irrigation engineer, Li Erh Lang. Note the contrast: incense sticks glow in the front of Li Bing's temple, but in its second court are numerous models of the improvements it is intended to make to the irrigation scheme. So also in Li Erh Lang's temple, the engineers have their living quarters, and the shrine and courtyard of Ta Yü is the Water Conservancy Office. In the middle of all this ancient culture, all these exquisite buildings, Li Bing's latest successor walks about, a slide-rule sticking out of his pocket, and with a Manchester training—Dr. Chang Yo-Ling. The British Scientific Mission has had particular pleasure in transmitting some of his papers for publication in British engineering journals.

It would be a delight also to speak of the chemists and engineers in the arsenals in this part of China, of their initiative and perseverance in erecting and operating up-to-date plants in the midst of the wilderness, and of the clever use that has been made of natural caverns for the protection of war science laboratories and special up-to-date machinery. But for security reasons this cannot be done. No one, however, could say, after seeing what the Chinese have done in technology, both ancient and modern, that they are a people inapt for the scientific control of Nature. If modern science did not develop in their country, it must have been due to specific inhibitory social and economic factors, and certainly not to any incapacity of the people themselves.

The tragic feature in to-day's situation is the economic straits of Chinese scientific men, especially in the universities. The steeply rising cost of living has hit them very hard, and neither the special rice allowances of the Government, nor the staving off of the evil day by the gradual selling of all the family possessions down to the children's dolls, avail to provide them with even a moderate standard of comfort and to guard against malnutrition. But this must be the subject of a later communication.

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# FEEDING HORSE CHESTNUTS AND ELDERBERRIES TO POULTRY

By H. TEMPERTON

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THE commercial poultry keeper, faced with an acute shortage of concentrate feeding stuffs, has been compelled to exercise considerable ingenuity in finding suitable supplements to eke out his food allocation and so maintain a reasonable proportion of his pre-war numbers of stock. The same problem, although to a lesser degree, has confronted the domestic poultry keeper, who is allocated sufficient meal to furnish approximately half the daily food requirements of his birds. Thus a person qualifying for rations for only four birds requires an additional half-pound of dry food substance in order to provide a satisfactory daily ration for this number of stock. It is estimated[1] that the daily amount of edible waste in the average small English household is approximately one pound of fresh substance, or approximately four ounces of dry matter. The further daily requirement of four ounces of palatable and nutritive dry matter must, therefore, be derived from other sources. The poultry Press, adopting the principle that no potential food source, however small in quantity relative to needs, should be despised, has frequently suggested the nutritive possibilities of natural food materials and requested youth movements and other voluntary services to collect acorns, horse chestnuts and beech mast for stock feed.

Reference to the available literature provides little experimental evidence of the value and effects of feeding such natural food materials to poultry, and it was considered desirable to obtain timely information. The use of acorns as a food for laying birds has already been described[2], and the present article gives an account of experiences with the feeding of horse chestnuts and elderberries.

## Horse Chestnuts

The chemical composition of horse chestnuts is very encouraging, the dry matter being similar to barley, as shown by the following analyses (Woodman[3]):

| | Average Composition Per Cent | | | | | |
|---|---|---|---|---|---|---|
| | Dry Matter | Protein | E.E. | N.F.E. | Fibre | Ash |
| Barley .. .. | 85·1 | 10·0 | 1·5 | 66·5 | 4·5 | 2·6 |
| Horse Chestnuts (Fresh) .. | 50·8 | 4·3 | 1·5 | 40·9 | 2·5 | 1·6 |
| Horse Chestnuts (Dry) .. | 81·2 | 6·9 | 2·4 | 65·2 | 4·1 | 2·6 |

A characteristic constituent of the nitrogen-free extractives is a glycoside, esculin (æsculin, æsculinic acid) $C_{15}H_{16}O_9$, which on hydrolysis yields esculetin (æsculetin, 6,7-dihydroxy-coumarin) $C_9H_6O_4$ and glucose. Horse chestnuts also contain the glycoside quercitrin (quercinetrin, quercitrinic acid) $C_{21}H_{32}O_{16}.2H_2O$, which includes the ω-desoxy sugar, *l*-rhamnose. On hydrolysis, quercitrin yields quercetin (meletin, sophoretin, quercitrinic acid, flavin) $C_{15}H_{10}O_7$.

Esculin is a saponin and produces the characteristic soap-like foam which is apparent when cooked horse chestnuts are masticated. A sweet flavour remains which later turns to a bitter after-taste due to the presence of *l*-rhamnose and of gallotannin (gallotannic acid), a further constituent of horse chestnuts. Gallotannin is largely hydrolysed to gallic acid during the cooking of the nuts. Klimmer[4] refers to deaths among poultry due to tannic acid poisoning following the feeding of horse chestnuts. It is unlikely, however, that this constituent was responsible, since in an experiment[5] carried out with laying pullets the daily dosage of birds with 1·12 gm. of gallotannic acid over a period of twenty-five days did not adversely affect health or egg production although the birds were costive.

*Outline of experiment.* Four groups each comprising four cross-bred pullets which were in lay were used

for the test and accommodated in individual cages in a battery house. Horse chestnuts at the daily rate of ½ oz. per head were added to a ration consisting of 4 oz. of a balanced laying meal. Four forms of air-dried ground chestnuts were fed as follows:

*Group* 1. Raw chestnuts.

*Group* 2. Boiled chestnuts.

*Group* 3. Chestnuts which had been steeped in water for forty-eight hours prior to cooking.

*Group* 4. Chestnuts which were leached in warm water for forty-eight hours after cooking.

The various forms of chestnuts were mixed with the appropriate quantity of mash and fed as a wet feed. All four rations proved markedly unpalatable and no improvements in this respect resulted from the efforts to debitter the chestnuts fed to groups 3 and 4. Where the birds could discriminate, the particles of chestnuts were thrown out of the troughs and they only ate the meal portion. In groups 2, 3 and 4 where the chestnuts were cooked and mixed intimately with the mash so that the birds were unable to distinguish the individual components, the ration as a whole was left untouched. A new set of birds which had had food withheld for the previous twenty-four hours were offered the four rations. Although obviously hungry they refused to eat more than a preliminary mouthful.

The supply of horse chestnuts used for the test was made available through the industry of local schoolchildren. The nuts were collected soon after they had fallen from the trees and stored in thin layers on the floor of an airy shed and turned frequently. Despite these precautions, 50 per cent (a conservative estimate) became useless for feeding purposes due to fungal infections. These were sorted and so far as possible not used for feeding.

The unpalatability of the material used must therefore have been due to the substances inherent in the chestnuts, and on the basis of this experience point to the unsuitability of horse chestnuts as a poultry food.

## Elderberries

Elderberries have been advocated as a supplementary food for poultry, fed either in the fresh state or dried for use in the winter as a scratch feed. It is obvious at the outset that owing to their high water content, no substantial quantity of concentrate feed is likely to be conserved by their use in a fresh condition since the extent of replacement is limited by the capacity of the fowl's digestive system. Moreover, it is doubtful whether it is worth drying the fruits in view of the excessive shrinkage.

Two species of elder are widely distributed in the British Isles, the common elder, *Sambucus nigra*, and to a much lesser extent the dwarf elder, *Sambucus ebulus*. Both species are credited with strong purgative properties, and cases of poisoning have been reported following the ingestion of berries from the dwarf elder.

Elderberries are known to contain a cyanogenetic glucoside, sambunigrin $C_{14}H_{17}NO_6$, which has been shown to be identical with the intermediate product mandelic nitrile glucoside (prunasin) formed in the hydrolysis of amygdalin. This would suggest that the use of elderberries as a stock feed involves some risk, more especially if included in a wet mash which is allowed to stand for any length of time before feeding, since enzymatic hydrolysis may proceed to the extent of liberating free hydrocyanic acid. Drying elderberries is said to reduce the toxicity.

Reference to the available literature indicates that the pharmacological effects are not very definite. Small quantities apparently purge animals and large intakes produce cardiac acceleration and severe emetic, cathartic and diuretic effects.

*Outline of Experiment.* Two groups each comprising six laying pullets were used for the feeding trial and housed in individual cages in a battery house. Both groups were fed a balanced mash at the daily rate of 4 oz. per bird. In addition, green unripe fruits and fully ripe black berries from the common elder were added in daily amounts of 1 oz. per bird for groups 1 and 2 respectively. At the commencement of the test the daily quota of berries were placed on the surface of the mash in order to obtain preliminary indications of their palatability. The ripe berries were relished by the birds, who ate them in preference to the mash, but the green fruits proved quite unpalatable and practically none was eaten. The fæcal portion of the excreta voided by the birds in group 1 became an intense purple colour twenty-four hours following the first feed and remained like this so long as the elderberries were fed. The physical consistency of the droppings and of the urine fraction was quite normal, however, and there were no indications of diarrhœa or diuresis.

After ten days the daily quantities of both forms of elderberries were crushed, mixed with the meal and fed as a wet mash. The ration containing ripe elderberries continued to be eaten readily, but the unpalatability of unripe berries was again marked, the mixed ration for group 2 being consumed reluctantly and part of the daily allowance invariably left in the troughs at the end of the day. This residue was mixed with the following day's food so that the effects of feeding material which had had favourable conditions for the hydrolysis of the glucoside could be observed. No harmful effects from either diet was noticed as a result of feeding the two rations for a period of thirty days. The birds in group 2 lost weight due to the subnormal food intake. Eggs which were laid by the experimental birds were broken and their contents examined. In every case these were described by independent co-operatives as perfectly normal in appearance and flavour.

It would seem from this limited test that no harmful effects to the health of laying birds or to the eggs they produce are likely to occur through the consumption of berries of the common elder (*Sambucus nigra*). Unripe berries are disliked by fowls and adversely affect the palatability of rations with which they are incorporated. Domestic poultry keepers with ready access to supplies may include ripe elderberries in the rations for their birds to provide variety and for condimental properties, but owing to their high water content it is obvious that no substantial saving of concentrate feed is likely to result from their use.

[1] Agricultural Research in Great Britain, 1943, p. 83. H.M. Stationery Office.

[2] Temperton, H., *Emp. J. Exp. Agric.* (in the press).

[3] Woodman, H. E., "The Composition and Nutritive Value of Feeding Stuffs", Bull. 124. Ministry of Agriculture.

[4] Klimmer, M., "Scientific Feeding of the Domestic Animals" (London: Baillière, Tindall and Cox, 1923).

[5] Temperton, H. Unpublished data.

# MEGATECTONICS AND MICROTECTONICS

By S. I. TOMKEIEFF
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TECTONICS is a branch of structural geology concerned with the deformational structure of the earth's crust as a whole and of its major and minor elements. It was Nicolaus Steno who in 1669 laid the foundation of the science of tectonics, but it was not until the beginning of the nineteenth century that tectonics assumed the character of an inductive science. During its earlier stages, tectonics was concerned only with the larger features such as folding, faulting and jointing, but with the advent of the microscope in geology, smaller features of rocks came to be studied. The pioneer of microscopical methods in petrology was H. C. Sorby, whose series of papers published between 1850 and 1860 opened up a new line of research both in the mineral composition and in the texture of rocks. After 1860 the attention of petrologists was concentrated mainly on the study of the composition of rocks, and their textural aspects were treated only from a descriptive point of view. The study of larger features of the earth's crust, however, proceeded with increasing vigour and scope.

During the last few decades remarkable progress in the field of tectonics has been made along two distinct lines of advance. One—through the study of the large features of rocks, such as schistosity, flow banding, jointing, etc. (megatectonics); the other—through the study of smaller features of rocks, such as the disposition of the constituent minerals, cleavage, schistosity, etc. (microtectonics).

Megatectonics deals with the large-scale deformations of the rocks and their resulting structures. These large-scale features vary in magnitude from large folds, faults and overthrusts to banding, foliation, schistosity and jointing. Broadly speaking, all these features can be subdivided into those depending on the fluid or plastic deformations of rock material (for example, magma) or rocks (flow or flowage structures), and those depending on the rigid deformation (fracture structures). The main object in magatectonics is to find the relation existing between the structures (which are observed) and the deformations which gave rise to these structures (which are inferred).

Flow and flowage structures are found in igneous and metamorphic rocks. In the former they were usually produced while the rock was still in a liquid or plastic state (primary flow structures), and in the latter while the rock was in the state of solid plasticity (secondary flow structures or flowage structures). In the primary flow structures the principal structural elements are: (*a*) flow lines, such as linear arrangement of unequidimensional crystals, clots, inclusions, etc.; and (*b*) flow layers (bands and schlieren).

Fracture structures are found in rigid rocks that have been subjected to deformations exceeding the limits of a plastic flow. In certain cases fractures can even be produced in material undergoing plastic deformation, such as viscous magma prior to its crystallization. The principal fracture structures are joints and faults. Joints can be classified into contraction (cooling, desiccation), expansion, dynamic, dynamo-plastic, and compression joints. The dynamo-plastic joints are related to flow structures. Such joints are usually found in plutonic igneous rocks and they are classified into cross-joints (normal to flow lineation or flow layers), longitudinal joints (parallel to flow lineation and normal to flow layers), and flow joints (parallel to flow layers).

Numerous geologists, among whom may be mentioned Van Hise, Leith, Mead, Heim and Becke, have added much to our knowledge of megatectonic features. It was Hans Cloos, however, who was first to attempt a systematic study of flow and fracture structures in plutonic and volcanic rocks. His principal object was to co-ordinate the various structures in such a way that a reasonable deduction could be made regarding the movements which gave rise to these structures. Since his original publication in 1921[1] this work has been aptly summed up by himself[2], by his brother Ernst Cloos[3] and by R. Balk[4].

As applied to igneous rocks, megatectonics was called igneous tectonics (granite-tectonics, if applied to granites). Probably the most interesting and also the most difficult problem of igneous tectonics is that of the study of batholiths and related intrusive forms. In this study the two fundamental problems—the origin and the mode of emplacement of the rock—are closely related, and it is here that the method of Cloos seems to be most applicable. Numerous works dealing with this problem have been recently published. Among them one may single out the publications of the Committee on Batholith Problems (bibliographies, abstracts of papers), the series of papers published in the report of the sixteenth session of the International Geological Congress (Washington, 1936, vol. 1), and the works of E. M. Anderson and J. E. Richey on ring-dykes, cone-sheets, etc.

Great progress has also been achieved in the field of microtectonics. Ever since the introduction of microscopical methods into petrology the study of rock textures has been an integral part of this science. Texture, as we know, embraces three aspects of the smaller features of rocks: (*a*) crystallinity—the degree of crystallization; (*b*) granularity—the size of crystals; and (*c*) fabric—the shape and arrangement of crystals. Microtectonics is mainly concerned with the fabric of rocks. Certain rocks, such as gneiss or schist, show clearly a definite parallel orientation of crystals, while other rocks, such as granite or basalt, as a rule do not show any marked orientation of crystals. The first class of rocks have, therefore, been called structurally anisotropic rocks, and the second class have been termed structurally isotropic rocks. The new method of study developed by Sander and Schmidt has revealed that many of the structurally isotropic rocks exhibit a certain hidden anisotropy in the arrangement of their component crystals. This new method, based on statistical interpretation of quantitative data, opened up a new line of development in petrology, and at the present time we can already distinguish *compositional petrology*—a science dealing with the mineralogical and chemical aspects of rocks—and *structural petrology*, a science dealing with the arrangement in space of minerals in rocks relative to megascopical characters and field position. The principal idea underlying structural petrology is that the arrangement of minerals in rocks is due to certain movements which have affected the rock either during or after its consolidation. Structural petrology has also been called petrofabrics, petromorphology or petrogeometry.

The modern development of structural petrology is due to Bruno Sander, who in 1911[5] showed that in certain structurally isotropic rocks, such as quart-

zite, the grains, if studied by optical methods, are definitely orientated, that is, their crystallographic lattices show a preferred orientation. This internal orientation, in contrast to the dimensional orientation of grains (which quartzite does not possess), was called the space-lattice or crystallographic orientation.

The original approximate statistical method of Sanders was eventually placed on a rigid quantitative basis by Becke[6] and Schmidt[7]. This new method consists of determining the position of the optic axis (or any other standard direction) of a mineral grain by means of Fedorov's universal stage. This vector is plotted on an equi-areal projection. The plane of projection is usually chosen to correspond with some megascopical feature of the rock. A number of grains being thus measured and plotted on the diagram provides an assemblage of dots. After counting the number of dots per unit area, equal density curves (similar to contour lines on maps) can then be drawn. The petrofabric diagram thus prepared gives a statistical picture of the orientation of certain selected vectors of crystal grains (usually optic axes of uniaxial crystals or cleavage planes of mica) in relation to some selected megascopical feature or features of the rock, for example, plane of schistosity, cleavage, bedding or geographical orientation.

The application of this method to the study of rock fabrics has been described in great detail by Sander[8] and Schmidt[9]. Sander's book is inordinately obscure, partly on account of the intrinsic difficulty of the subject, but mainly because of the cumbersome method of exposition. It is full of new terms for which there are no adequate English equivalents and of which the meanings are unfamiliar to ordinary petrologists. English versions of structural petrology have been published by E. B. Knopf and E. Ingerson[10] and H. W. Fairbairn[11]. These two books, which in certain respects are complementary to each other, embrace the whole field of structural petrology, and give a very clear picture, so far as the nature of the subject will allow, of this intricate science, besides providing a complete list of references. The book by Knopf and Ingerson is wider in its scope and more gradual in its approach, while the book by Fairbairn is more detailed in a restricted field.

A novice may at first be discouraged by the intricacies of structural petrology and especially by its terminology; he may even be tempted to reject the whole of it as a piece of elaborate nonsense, a mountain made out of a molehill. However, this attitude of prejudiced criticism is unwarranted; in the past, many attempts to introduce new methods in science have initially met with scant approval. It nevertheless remains true that the methods of structural petrology are far from simple and that the interpretation of the data obtained is often ambiguous.

The technique of structural petrology falls into four successive stages. The first stage, collection and slicing of orientated sections, is quite a simple process. The second stage, the measurement on the Fedorov's stage, is a rather laborious and time-consuming process. The third stage, the preparation of petrofabric diagrams, is comparatively simple. The fourth and last stage, the interpretation of petrofabric diagrams, is really a difficult process full of snags and pitfalls. The problem which has to be solved is the deduction from the symmetry and density areas of the diagram of the direction of the movements which determined this particular rock fabric, and this is not easy.

Several types of rock fabrics can be distinguished: isotropic, anisotropic, homogeneous, inhomogeneous, depositional, deformational, superimposed, etc. Fabrics are also distinguished by their symmetry and by the pattern of density belts and density areas. Especially complex is the problem of dynamo-metamorphosed rocks, not only because the original fabric has been modified, but also because the movements affecting rocks in their solid state are highly complex. The chief difficulty, however, is that the nature of the orientating process is still a matter of conjecture, since we have no precise knowledge as yet of the internal mechanism of solid flow.

The science of petrotectonics is still very young; it suffers from growing pains and from an infantile rash of terminology; its methods are laborious; its principles still very uncertain. To some, the application of petrotectonics to geology may appear like the construction of an elaborate gun for the purpose of killing a fly. Nevertheless, there are definite indications that petrotectonics may eventually become an important adjunct of petrology and geology. Here are a few selected examples of its application.

Macrotectonics has its limitations—structurally isotropic rocks like some granites and quartzites are 'dumb' until subjected to petrofabric analysis. Schistose metamorphic rocks do not always reveal the direction of movements which affected them during their metamorphism. A number of microtectonic investigations on these types of rocks have thrown important light on the problem of metamorphism. The investigation by F. Coles Phillips on the tectonics of Moine schists[12] furnishes an admirable example. The mineral orientation in the Moine schists supports the hypothesis that the Moine metamorphism is of pre-Torridonian age, that the movement which produced the metamorphism acted along approximately south-west and north-east lines, and that the later Caledonian movement acting on north-west and south-east lines had apparently little effect on the fabric. On the other hand, the petrofabric study of the so-called "Tarskavaig-Moine" series[13] suggests that their fabric is related to the south-east movement.

The application of petrotectonics to problems of economic character has also been attempted with marked success. G. W. Bain, for example, has shown that various properties of marble, such as the maximum and minimum strength, ease of sawing, ability to transmit light, etc., depend on the orientation of calcite crystals in the rock. By means of petrofabric analysis Bain was able to select the most favourable direction for sawing slabs of marble in the position most favourable for transmitting light[14].

These are only a few examples of the application of petrofabric analysis to scientific and applied problems. Many others are on record in spite of the comparatively short period during which the development of petrotectonics has been in progress. It is safe, therefore, to predict an assured success for both microtectonics and megatectonics, especially if these two branches are closely combined and their methods and terminology standardized and simplified.

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# OBITUARIES

## Dr. Aleš Hrdlička

By the death of Dr. Aleš Hrdlička, which occurred in Washington, D.C., on September 5, at the age of seventy-four, the United States loses its leading exponent of physical anthropology, and anthropologists throughout the world a loyal and helpful friend. He was born of Czech parents who emigrated to the United States, carrying their young family with them, Aleš being the eldest of four boys.

Hrdlička's early life was a struggle, but by the age of twenty-two we find him a qualified homœopathic physician; later he took an allopathic degree. As soon as he qualified, we see him pursuing a practice which he continued with remarkable assiduity throughout life, that of observing, recording and publishing the interesting things he met with in his daily life. For Hrdlička, right from the beginning of his career to the end of it, was a quarryman, an assembler of building material, rather than a builder; he had a firm faith that master-builders would come along and find his materials of service. So it was when he became anthropologist to the Pathological Institute of the New York State Hospitals in 1896; he began measuring and recording the physical characters of the insane. At the beginning of the present century he passed from medicine to anthropology, becoming a member of the staff attached to the Department of Physical Anthropology in the U.S. National Museum, Washington. In 1910 he became curator of the Department and continued in that office until 1942; even then he did not retire but withdrew to the Smithsonian Institution, where he continued his labours until his sudden end.

During the period of his curatorship Hrdlička gathered personally, or acquired, representative collections of skulls and skeletons of men and anthropoids from their native regions in all parts of the world, aiming at giving each variety of mankind a full representation in the national museum, particularly those races which were, or have been, native to America. From time to time he issued reports on these collections, chiefly in publications connected with the museum. It was characteristic of him that he was never satisfied with reported discoveries of fossil man until he had examined the bones with his own eyes and measured them with his own callipers; no matter how out-of-the-way the site of discovery might be, in China, Java, Australia, Africa, Europe or South America, he made his way thither, held an inquest and returned with a documented report. The first of these reports appeared in 1913; the last and most valuable in 1930 (*Smithsonian Misc. Coll.*, vol. 83). He gave particular attention to discoveries of ancient man made in America, and seemed to take delight in reducing their antiquity to the lowest possible factor, and their type to that of the American Indian—in doing which his perspicacity was probably not much at fault.

Although Hrdlička grew up a fervid American, he retained a strong affection for the land of his birth, especially for its strong school of Czech anthropologists; they in turn were proud of him; on the occasion of his sixtieth birthday (1929), they celebrated the event by bringing out a Hrdlička volume of their publication *Anthropologie*. On the occasion of his seventieth birthday he was again honoured by having dedicated to him a volume of the *American Journal of Physical Anthropology*, to which colleagues at home and abroad contributed. It was fitting that this journal should celebrate the event, for it was Hrdlička's 'bairn'; he brought it into life in 1918, nourished and protected it until it grew into a hardy independence, and then handed it over to the Wistar Institute.

To aid in the celebration of this jubilee, Dr. D. Rubin de la Borbolla drew up a classified bibliography of Hrdlička's publications (*Boletin Bibliog. Anthropologia Americana*, vol. 2; 1939); between 1892 and 1938 they numbered 295. Clearly a review of such a literature does not fall within the compass of this notice; suffice to say that skull and brain, long bones and short, were subjected again and again to detailed report. In what may be called his field-work he centred his attention on the population of the United States, both living and extinct; on the changes produced by the arrival of millions of central Europeans in the first decade of the present century; the persistence of the British type in the descendants of early colonists ("Old Americans", 1925); more especially was his attention given to the American Indians, both to living representatives and to their predecessors, unearthed from ancient graves. No problem occupied his thoughts so continuously as that of the origin and homeland of this interesting race; his search for evidence turned his footsteps towards Alaska, and to the neighbouring region of Asia, which he finally concluded must be regarded as the cradle of the Amerind type.

In 1927 Hrdlička came to London to give the Huxley Lecture to the Royal Anthropological Institute and receive the Huxley Medal. In the spring of 1939 he again arrived in London, where he had arranged to give lectures at University College, and then to pass on to Russia, where important discoveries of fossil man had been reported. On leaving ship he had a sudden heart seizure (coronary thrombosis), lay for weeks in University College Hospital, made a surprisingly good recovery, gave his lectures and then made his pilgrimage to Russia.

In August of the present year I received from Hrdlička an autographed copy of what has proved to be his last book; it is entitled "Alaska Diary" (Cattell Press, Penn., 1943). Between 1926 and 1938 he made ten expeditions to Alaska, to study Eskimo and Indian, and to search for evidence bearing on the coming of the Amerinds; the "Diary" refers to the explorations made between 1926 and 1931. "These records", wrote Hrdlička, "have no pretense to any literary value, nor to any virtue aside from reality. They are just brief but faithful records of what befell or what was encountered by the writer."

With the "Alaska Diary" came a letter to me written by Dr. Hrdlička on June 23, some ten weeks before his sudden end. A few brief extracts from this

letter will bring home to readers what kind of man he was better than anything I can tell them. "Future American histories of England", he said, "will be written in quite different, and much more honored and proud terms than were those of the past. May the English-Russian relations, also, continue and grow ever deeper. With those two realms going hand in hand, Europe will be effectually healed and restored, and so will much of the Old World; without it there would be misery and chaos." He took a rather pessimistic view of the future of his own subject: "I keep on, as formerly, and may yet see something accomplished even after the Alaska reports are off my shoulders. But conditions are rather disheartening; physical anthropology is in a deep trough. With anatomists weaned off from Anatomy and Anthropology, and the young would-be anthropologists impatient of sufficient preparation and so turning into flimsy statisticians, there are few chances in sight for a rejuvenation. . . . The basic reasons for the decline are plain enough. Those parts of anthropology that most appealed to the imagination and held most promise, have to a large extent been covered and failed to either satisfy or definitely solve matters. . . . But enough of this. If I have troubled you with it, it was with some faint hope that you might show me I am wrong, or getting old, or disgruntled, or something. As a matter of fact, I will the next minute be head-over-heels in happy and absorbing work on my old friend the tibia; and my head is full of plans and happy anticipations as to where I will go and whom to see after the war; and the seeing through of the three Alaska volumes is a real work of love." A. KEITH.

## Dr. A. H. Evans

ALTHOUGH it was published just before the opening of the present century, the volume on "Birds" by A. H. Evans, in Harmer and Shipley's "Cambridge Natural History", remains a well-used text-book. It is more readable than most text-books, it deals lightly and inadequately with structure (but then Beddard's work had appeared only the year before), and it concentrates upon the classification and particularly upon the appearance and habits of the birds themselves. This was almost to be expected, for Evans was essentially a field naturalist. In his schoolboy days at Durham, his interest in birds had been encouraged by Canon Tristram; at Cambridge, in the seventies of last century, it was confirmed by Alfred Newton; and the majority of his scientific contributions are records of observations in the field and faunal lists of areas he knew well.

Scotland gained much from Evans's frequent visits. To the fine series of vertebrate faunas of that country edited by Harvie-Brown and Buckley, he wrote, with the latter, "A Vertebrate Fauna of the Shetland Islands" (1899), and followed this with his own "Fauna of the Tweed Area" (1911); he also contributed occasional records to the *Annals of Scottish Natural History*. But his interests were not confined to local ornithology: with S. B. Wilson he described the birds of the Hawaiian Islands—"Aves Hawaiiensis" (1890–99); he wrote for the *Ibis* descriptions of his visits to South Africa and Australia with the British Association; he translated and annotated under the title "Turner on Birds" (1903) the rare sixteenth century "Avium Praecipuarum, quarum apud Plinium et Aristotelem mentio est, brevis & succincta historia" of William Turner, reputed father of British ornithology.

Evans took his share also in the conduct of ornithological affairs: from 1884 until 1889 he was recorder of the section "Aves" in the *Zoological Record*; from 1901 until 1912 he shared with P. L. Sclater the editorship of the *Ibis*; for some eight years he was guardian of Hickling and Horsey Broad for the owners; he was National Trust local secretary for Wicken Fen, and wrote an account of the Fen birds; he was president of the Berwickshire Naturalists' Club, and joint editor and vice-president of the British Ornithologists' Union.

These by no means exhaust the accomplishments of A. H. Evans, but they give the impression of a man of energy and activity, of learning and enthusiasm. Arthur Humble Evans was born in 1855, son of the vicar of Scremerston, Northumberland, and after graduating at Cambridge in 1879 (later he was awarded the Sc.D. degree) he continued there, teaching and tutoring in subjects which included English history and economics, for almost fifty years. When he was eighty-four years of age he published a "Flora of Cambridgeshire" and shortly before paid his last visit to a meeting of the Royal Society of Edinburgh. He died on March 28, 1943, having passed by little more than a month the eighty-eighth anniversary of his birth. JAMES RITCHIE.

## Prof. F. Bacon

ENGINEERS in many parts of the world who received their training at the University College of Swansea under Prof. Frederic Bacon, and the many others who came in contact with him through his varied activities, will learn with great regret of his sudden death, which occurred at Earlestone Common, near Newbury, on August 23.

Prof. Bacon, who was sixty-two, was the son of the Rev. J. M. Bacon, the scientific aeronaut. His first practical experience was obtained with Plenty and Sons, engineers, at Newbury. In 1899 he went to Trinity College, Cambridge, where he won an exhibition and studied under the late Sir Alfred Ewing. In 1902 he obtained first-class honours in the Mechanical Science Tripos. After further practical experience with Yarrow and Co. at Poplar and the British Westinghouse Electrical and Manufacturing Co. at Trafford Park, Manchester, he was appointed in 1905 to the teaching staff at the Royal Naval College, Greenwich, and later he also gave special lectures on the photo-microstructure of metals at University College, London.

In 1913 he was appointed professor of engineering in the University College of South Wales and Monmouthshire at Cardiff, and on the outbreak of the War of 1914–18 he organized the facilities of the Engineering Department for the manufacture of precision gauges required for shell manufacture. Later he served as lieutenant R.N.V.R. attached to H.M.S. *Vernon* in connexion with the design and development of paravanes, etc. Afterwards he was transferred to the Anti-Submarine Division of the Admiralty as technical expert in the experimental development of anti-mine and anti-submarine devices. In 1920 the chair of engineering was created in the University College of Swansea, and Prof. Bacon was appointed to this position, which he held until his death.

Prof. Bacon was a born research worker and

investigated a number of problems in connexion with fuel economy, dust prevention, wind pressures, etc., but the work for which he will be best known was on fatigue, cracking and fracture of various materials. The most important papers on this work were: "Fatigue Stresses with special reference to the Breakage of Rolls" (*Proc. South Wales Inst. of Eng.*, 1930); "Fatigue and Corrosion Fatigue with Special Reference to Service Breakages" (*Proc. Inst. Mech. Eng.*, 1933), for which he was awarded the T. Bernard Hall Prize; "The Relation of Fatigue to Modern Engine Design" (*Trans. N.E. Coast Inst. Eng. and Ship.*, 1935). This last paper was in conjunction with two other engineers and was awarded the M. C. James Gold Medal.

A very large number of other papers and lectures on fatigue and allied problems were given to various engineering and technical societies, both in Great Britain and Germany; his last investigation, undertaken at the request of a Government Department, was on the notch sensitivity of certain materials under cyclic stress.

Prof. Bacon devoted much time to the leading engineering institutions; he took a prominent part in the formation of the South Wales branch of the Institution of Mechanical Engineers, was its secretary for several years and became its chairman. He was also a past president of the South Wales Institute of Engineers and served on the committees of the local sections of the Institutions of Civil and Electrical Engineers.

Although of a naturally reserved disposition, those who knew him best will remember his charm of manner as well as the unstinting interest he took in his students.

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We regret to announce the following deaths:

Prof. Frederick Barry, professor of the history of science in Columbia University, aged sixty-seven.

Prof. A. D. Bevan, professor of surgery in the University of Chicago, on June 10, aged eighty-two.

Mr. P. J. Haler, M.B.E., principal of the South-East Essex Technical College, on September 13, aged sixty-seven.

Prof. R. A. von Muttkowski, professor of biology in the University of Detroit, on April 15, aged fifty-six.

Mr. Colin F. Symington, of the Malayan Forestry Service, on September 9.

Mr. C. C. Willoughby, emeritus director of the Peabody Museum of Harvard University, on April 21, aged eighty-five.

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# NEWS and VIEWS

## International Air Transport

A BROADSHEET (No. 208) entitled "International Air Transport", which P E P (Political and Economic Planning) has put forward as a contribution to the widespread discussions now taking place, is concerned with the extent to which the organization of international transport can be entrusted to international bodies. It reaches the main conclusion that there is a strong case for setting up an International Board for Air Navigation and for international public corporations for the operation of certain international services. A start should be made with corporations for Europe and for the North and South Atlantic. It is suggested that out of the large-scale emergency air-services which the United Nations will need to operate in the immediate post-war years to the shattered areas, distributing food and medical supplies, and carrying officials, medical men and technicians, a European airways corporation could naturally grow. Discussing future prospects, the broadsheet considers it certain that air transport will carry more and more international passenger traffic, cost and speed being two of the determinants. Much pre-war ocean travel in the first and cabin classes will be shifted into the air. Air mail is also likely to become more and more important.

The spirit of international co-operation will be essential if the opportunities are to be realized. Co-operation will be essential if air transport is not to continue a creature of nationalism, hampered by lack of freedom of the air and artificially stimulated by subsidies. Co-operation will be necessary to secure common technical standards. Unlimited competition among commercial operators is not likely to be tolerable, pooling agreements to mitigate the waste of competition will be insufficient, and some measure of international co-operation will be essential. This, however, involves reversal of many of the policies pursued in the past. The broadsheet visualizes a system of collective security in which an international police force plays a part and an international board for air navigation, following the precedent of the International Commission for Air Navigation established under the League of Nations. The possibilities of commercial co-operation have already been demonstrated by the International Air Traffic Association.

## Reconstruction of the Social Order

IN a memorandum on the reconstruction of the social order, entitled "Peace and the Threefold Commonwealth" (London: Rudolf Steiner Publishing Co.; New York: Anthroposophic Press, 1943, 1*s*.), Mr. T. G. Jones gives an outline of the ideas of Dr. Rudolf Steiner as indicated more particularly in his books "The Threefold Commonwealth", "The Social Future and World Economy". The human social order is a threefold structure consisting of a body economic, the sphere of the State and a spiritual or cultural life. These are at present so entangled that none of them can develop fully on its own proper basis. If each of these parts of the social order is allowed to develop on its own proper ground it will bear rich fruit for the healing of social disease, and co-operation of the three parts to establish a threefold articulated healthy social order will then be possible. For this purpose economic associations for each industry and a Central Economic Council are suggested, and while the main task of Parliament would be to formulate and administer the code of rights, the economic associations would contribute from their surpluses to the economic support of the spiritual or cultural institutions.

The two main proposals in the memorandum are the allocation of a fair share of work between the several industries under the code of rights by determining mutually fair hours of labour, and the determination by the Central Economic Council of the total production of any one kind of goods and services. Each association would receive for its output a price comprising what it required to satisfy that

part of the total needs of consumption for which it was responsible. To achieve this it would be necessary to fix a standard economic value as a unit of money, and each association would sell its product at a price representing the economic value or "organised labour value", a kind of quotient of work done for the elaboration of a natural product and the organization and division of labour by the human spirit. By distributing these values among the manual, clerical and supervising workers belonging to the association, again according to the consumption needs for which the association is responsible, among the lenders of capital and, through the Central Economic Council, among those for whom the workers in the industry could be held communally responsible in proportion to their needs, it is suggested the root causes of conflict between employers and employed would be eradicated. Other suggestions relate to the provision of funds for new or extended economic enterprise and the issue of money so as to ensure that it is a true medium of exchange and no more, and to prevent the money in circulation exceeding the economic values created.

## The Kentucky Dam, Power House and Lock

THIS is a project of the Tennessee Valley Authority, and owing to the proximity of the site to the secondary zone of disturbance of the New Madrid earthquake of 1812, all structures forming part of the main dam were proportioned to resist seismic disturbances (*Earthquake Notes*, **14**, Nos. 3 and 4; June 1943). The following seismic loadings were adopted: for mass structures of great rigidity an equivalent inertia force equal to 0·05 g. and for less rigid structures an inertia force varying from 0·06 g. to 0·10 g., based upon rational calculations of the dynamic action of the structure. The seismic increase in reservoir pressures was calculated by the Westergaard formula, using an earthquake acceleration of 0·05 g. For the two large retaining walls at the end of the earth embankment at each side of the river, special investigations were undertaken to establish the proper seismic loading. An extensive programme of shaking-table tests was conducted at Leland Stanford University by Prof. L. S. Jacobsen. On the basis of these tests an equivalent inertia force of 0·18 g. was applied to the conventional Coulomb wedge, the point of application being about 0·60 the height above the base. For structures sustaining hydraulic loads, the increase in overturning moment due to seismic effect was only 7 per cent, while the corresponding increase for structures such as retaining walls carrying earth loads was of the order of 35 per cent. Maps recently sent out by the State Geologist of the State of Missouri indicate large anomalies in both gravity and vertical magnetic intensity in Stoddard County, the locality of the great New Madrid earthquake of 1811. Whether there is any significance in the coincidence is not established, but the seismic precautions mentioned above do not appear to lack wisdom.

## The Gas Industry in Great Britain

A BROADSHEET entitled "The Gas Industry in War-Time" (No. 210), which has been issued by Political and Economic Planning, brings up to date the report issued by P E P just before the War. It gives a concise factual account of the structure of the industry, including a note on the work of the Gas Research Board, to which gas undertakings representing 76 per cent of the gas output of Great Britain are now allied. Civil defence measures, man-power, the effect of the War on the distribution of demand, prices, fuel economy, coal supplies, gas quality, coke-oven gas, and trends in regard to coke and by-products are briefly surveyed. In regard to the last, six committees have been set up to investigate specific problems related to the replacement of imported by home-produced fuels, and to the most effective utilization of the latter in war-time, in particular the possibility of increasing the amount of liquid products—tar, creosote, benzene, toluene, etc.—obtained by high-temperature carbonization in gas-works and coke-ovens. Considerable progress has been made in the use of creosote pitch as a boiler and furnace fuel, although its high viscosity involves certain difficulties.

## Public Health in Uruguay

IN a recent paper (*Bol. Of. San. Panamericana*, 22, 394; 1943), Dr. J. C. Mussio Fournier, formerly Minister of Public Health in Uruguay, gives the following account of public health in his country during the period 1938–42: (1) extension of preventive services; (2) better distribution of public health appropriations; (3) considerable increase of hospital beds and in hospital construction; (4) intensification of the campaign against tuberculosis. The Health Division, Bureau of Health Examinations and departments of vital statistics, industrial hygiene and school prevention have been very active and the campaign against diphtheria has progressed. The appropriation for the Ministry of Health has increased 32 per cent. The present Government has spent 1,847,500 pesos on tuberculosis treatment, 590,000 for mental patients, 3,170,000 for the Clinical Hospital, 2,774,000 for improvements in Montevideo and 1,675,000 for rural construction. In 1937 Uruguay had only 1,055 beds for tuberculosis, a number far below present needs, as there are about 2,400 deaths annually from this cause in that country. To-day, however, Uruguay leads all Latin-American countries in the number of beds devoted to that disease.

## T. K. Sidey Summer-time Award

THE Royal Society of New Zealand invites applications for the T. K. Sidey Summer-time Award, consisting of a bronze medal and prize of £100, given for contributions to human knowledge by original scientific research in any of the following subjects: (1) the study of light, visible and invisible, and other solar radiations in relation to human welfare; (2) the general study of radiations of every kind. Such scientific research shall not be deemed to be limited to research in medical science. Primarily the award is to be made to a New Zealander or for work carried out in New Zealand, but the Council of the Society is at liberty to vary conditions and subject. Applicants for the award may submit either theses specially prepared or copies of published works. Applications should reach the Secretary, Royal Society of New Zealand, Victoria University College, Wellington, New Zealand, not later than January 31, 1944.

## *Mathematical Tables and Aids to Computation*

ON January 1, 1943, there appeared the first number of a new journal, entitled *Mathematical Tables and Aids to Computation*. It is published by the National Research Council (Washington, U.S.A.), and is to appear quarterly. The subscription is three dollars a year. The editor is Prof. R. C. Archibald,

chairman of the National Research Council's Committee on Mathematical Tables and Aids to Computation, to whose retirement from the chair of mathematics at Brown University reference was made in NATURE of August 21, p. 211. Some of the articles are bibliographical, such as one in the second number (April 1943) dealing with the various trigonometric tables with radian arguments. A valuable feature is a section on the description and location of unpublished tables. This, it is hoped, will not only help research workers, but also prevent useless duplication of costly effort. There is a section for queries and replies to them. The longest article in the first number is a list of eighty-eight recent tables, with reviews of the last fourteen and references to other journals where reviews of the first seventy-four can be found.

## Earthquakes during June

DURING June 1943 thirteen earthquakes were registered strongly by the seismographs at Kew Observatory. The strongest of these was on June 9. The shock began registration with *iP* at 03h. 19m. 56s. U.T. and attained a maximum amplitude of 420 $\mu$ at 04h. 09m. 55s. U.T. on the vertical component at Kew. It is estimated to have come from an epicentre some 10,700 km. distant. This earthquake was registered at Stonyhurst at 03h. 20m. 40s. U.T., beginning with *eP*. Three shocks were registered at Kew and Stonyhurst on June 13. The first was by far the greatest. It recorded *iP* on all three components at Kew at 05h. 23m. 59s. U.T., apparently coming from an epicentre some 9,100 km. distant. The first recording was compressional and the maximum amplitude at Kew was 270 $\mu$ at 06h. 00m. 45s. U.T. on the N component. Stonyhurst recorded the shock at 05h. 24m. 10s. U.T. The other two shocks on June 13 were probably aftershocks from the same epicentre. The German News Agency reported a shock on June 12, recorded at Württemberg Observatory at 6.22 a.m., and believed to have taken place in the Eastern Alps, but this movement was not significantly recorded at Kew.

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of three earthquakes in mid-June on the basis of instrumental reports received from observatories in America, Australia and New Zealand. The first was on June 13 at 5h. 11m. 44s. U.T. from an epicentre near 43° N., 142° E., which is near the central peak of Hokkaido Island, one of the Japanese Islands. The depth of focus was normal. The second was on June 14. The earthquake took place at 13h. 23m. 34s. U.T. at an epicentre near latitude 28·5° N., longitude 112° W., which is in the Gulf of California just south of the mouth of the Sonora River. The depth of focus was normal. The third earthquake was on June 15, occurring at 18h. 21·7m. U.T. from an epicentre near latitude 14·5° N., longitude 93° W., which is in the Pacific Ocean on the 100-fathom line west of the junction between Chiapas and Guatemala in Central America. This earthquake also had a normal depth of focus. The earthquake of June 20 was recorded at Kew and Stonyhurst. At Kew it recorded with *iP* at 15h. 38m. 04s. U.T. from an epicentre some 2,600 km. distant. It attained a maximum amplitude at Kew of 98 $\mu$ at 15h. 48m. 36s. U.T. on the vertical component. All interpretations and calculations are provisional.

## Gift by Prof. T. D. A. Cockerell

PROF. T. D. A. COCKERELL, emeritus professor of zoology in the University of Colorado, will be remembered by many readers of NATURE as a frequent contributor of communications on biological topics. So long ago as 1920, he produced a useful and distinctive book entitled "Zoölogy: A Text-book for Colleges and Universities", which was reviewed in NATURE of December 23, 1920, p. 529. This was not an ordinary text-book of its time, for it catered for the needs of those who were not intending to specialize in zoology, and so included chapters on social life, the evolution of man, eugenics and sociology from the biologist's point of view. In its general approach it was perhaps in advance of much of the thought of its day. The book was re-issued from time to time, and Prof. Cockerell has now had prepared, at his own expense, an impression of a thousand copies which have been presented to the Board of Education in Great Britain. The gift will be much appreciated, and the volumes will no doubt contribute in no small measure to the growth of that biological outlook on man and his affairs which are necessary for the future peace of the world.

## The Night Sky in October

FULL moon occurs on October 13d. 13h. 23m. U.T., and new moon on October 27d. 15h. 23m. The following conjunctions with the moon take place: Oct. 18d. 04h., Mars 4° N.; Oct. 18d. 14h., Saturn 2° N.; Oct. 23d. 07h., Jupiter 0·2° S.; Oct. 25d. 03h., Venus 4° S. The following occultations of stars brighter than magnitude 6 take place: Oct. 3d. 18h. 01·0m., 49 Lib(*D*); Oct. 8d. 18h. 43·5m., 19 Cap(*D*); Oct. 15d. 02h. 59·2m., $\mu$ Cet(*D*); Oct. 15d. 04h. 10·3m., $\mu$ Cet(*R*); Oct. 15d. 22h. 17·4m., *f* Tau(*D*); Oct. 15d. 22h. 58·6m., *f* Tau(*R*); Oct. 17d. 01h. 26·5m., $\gamma$ Tau(*R*). The times are given for Greenwich and *D* and *R* refer to disappearance and reappearance respectively. Mercury attains its greatest western elongation on Oct. 10. It is a morning star, and at the beginning of the month rises at 5h., an hour before sunrise. At the end of the month it rises at 6h. 15m., 35 minutes before sunrise. Venus is a morning star and rises at 3h. 17m. and 2h. 37m. at the beginning and end of the month respectively. The planet attains its greatest brilliancy on Oct. 13. Mars can be seen in the constellation of Taurus in the evening and sets at 12h. 32m. at the beginning of the month and at 11h. 05m. at the end of the month. On Oct. 28 the planet is stationary. Jupiter, in the constellation of Leo, is a morning star, rising at 1h. 30m. at the beginning of the month and at midnight at the end of the month. Saturn can be seen close to Mars and is stationary on Oct. 9. At the beginning and end of the month the planet sets at 12h. 40m. and 11h. 10m. respectively. Times are given approximately for the latitude of Greenwich. The Orionid meteor shower is due about Oct. 18–21. The radiant is close to the star $\nu$ Orionis.

## Announcements

PROF. EDWARD HINDLE, regius professor of zoology in the University of Glasgow, has been appointed scientific director of the Zoological Society of London.

THE following appointments and promotions in the Colonial Service have recently been made: J. D. Yeld, agricultural officer, Northern Rhodesia; T. Threlkeld (veterinary officer, Jamaica), senior veterinary officer, Jamaica.

# LETTERS TO THE EDITORS

*The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.*

## James Prescott Joule and the Unit of Energy

A CENTURY has passed since Joule read his paper on the relation between heat and work at the meeting of the British Association at Cork on August 26, 1843. It is unfortunate that a difference of opinion has arisen about the correct pronunciation of his name and also of the word *joule* used to denote a unit of energy (ten million ergs or one Newton-metre). The "Oxford English Dictionary" gives *dzaul* as the pronunciation of the unit, where *au* represents the sound in the word *loud*. In "Webster's New International Dictionary" (1911) is found the statement: "The proper name is pronounced *joul* (*ou* as in *out*) and this is the correct pronunciation for the unit; but the incorrect *jool* [*oo* as in *food*] is very common especially in the United States." In "Chambers's Technical Dictionary" (first published 1940) we find the contradictory statements

**joule**, jool (Phys.). A unit of energy equal to $10^7$ ergs.

(Named after F. [*sic*] P. Joule, 1918–89; name pronounced jowl.)

From boyhood I have been accustomed to the pronunciation *jool*, and was pleased to receive support for this from my colleague Sir D'Arcy Thompson, whose memories of the Royal Society of Edinburgh go back to the days of Lord Kelvin. He consulted Sir John Stopford, vice-chancellor of the University of Manchester, who replied on August 17, 1943: "I believe it is JOOLE and I never heard Jowle until comparatively recently when I think it came from the South. The family I knew in my youth insisted upon JOOLE and I think they were descendants". My friend Dr. George Green, of the University of Glasgow, was at one time private secretary to Lord Kelvin, and he writes (August 22, 1943): "The name Joule should rhyme with 'rule'. This is how Lord Kelvin pronounced it, and this has always been the pronunciation in Glasgow, as far as I can remember—by Prof. Gray (Senior) for instance." Prof. G. W. O. Howe (August 25, 1943) writes: "Some years ago I was troubled by the same question and I made enquiries—also in Manchester—and came to the conclusion that Joule and his relatives always pronounced the name 'joole'. I was pleased to learn this as I had always so pronounced it and regarded 'jowl' as a hideous mispronunciation".

I venture to suggest that the pronunciation 'Jowle' may have originated in Salford through the sardonic humour of local workpeople who, having in mind such an expression as 'cheek by jowl', spoke of 'Jowle's brewery'.

The pronunciation *joole* for the unit of energy (the joule) in the M.K.S. system of units has the advantage that it is immediately applicable in the French language—compare the words *boule* and *jour*. I am told by Mr. W. D. Oliphant, to whom I am indebted for much assistance in this question, that in the War of 1914–18 a French submarine (lost in the Dardanelles) was named *Joule*.

H. S. ALLEN.

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## Seed Selection in Forestry

I HAVE been expecting to see a protest from one of our leading plant geneticists against the casual treatment of the subject of genetical research in the White Paper on Post-War Forest Policy (Cmd. 6447), but as it has not drawn their fire, I must presume that it has not come to their notice, and so venture to write as a forester with limited experience in this field. Right at the end of the section on "Ancillary Research", among the "Miscellaneous Investigations" of paragraph 383, is a bald reference to "work on the origin of seed, i.e., the effect of selecting seed of a given species from different parts of its natural range (a large number of comparative plots have been established in different parts of Great Britain)". The only other reference is in paragraph 395, where research on tree breeding is dismissed as insufficiently urgent to justify taking it up among the major projects after the War.

Now the White Paper envisages for Great Britain the afforestation by planting or sowing of some three million acres of bare land, and the effective management, which must also involve extensive planting, of a further two million. The trees planted out now will remain from, say, 40–120 years; we have complete control of the choice of stock to be used, but no possibility whatever of remedying during those long periods any mistake made in its genetic suitability. One might well marvel that, in view of the classical disastrous errors made on the Continent and the almost complete ignorance of the subject for the exceptionally varied conditions of Britain itself, this field was not made one of the major subjects of research from the very initiation of national forestry after the War. That it should continue to be viewed as a minor sideline is, to say the least, astonishing. There are often good grounds for suspecting that the genetic constitution of the stock is primarily responsible for the badness of the inferior tree crops so often met with in most parts of Great Britain; yet the collection and distribution of tree seed continues to be almost entirely haphazard. Surely it would be worth waiting even several years to make sure of procuring the best strains available for each district. Helpful as existing experiments on the differences between seed from different (again ill-defined) sources may be, the scale and execution is utterly inadequate to the importance of the subject.

An immediate step called for doubly urgently at the beginning of the present War was the selection and preservation of suitable stands on an adequate scale for seed production, but this is only one of the steps needed. It is almost superfluous to point to the example set us by several of the smaller countries of Europe in this matter, including some where planting is a far less common practice than with us.

H. G. CHAMPION.

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Aug. 9.

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## Spray-Dried Rose Hip Powder

THE increasing interest that is being taken in natural sources of vitamin C in general, and in the extraction of this vitamin from rose hips in particular, suggests that some observations made by us on the production of a spray-dried rose hip powder may be of interest. In the autumn of 1942 it was desired to

prepare a concentrated rose hip extract with high ascorbic acid potency, but a vacuum-evaporated extract proved to be somewhat unstable. In view of our previous success with the spray-drying of apples, plums and black currants, it was decided to apply the earlier technique to rose hips.

An extract of the fruit was made by boiling the milled hips with twice their weight of water for half an hour, the liquor being removed by hydraulic pressure. By this means a thick pectinous fluid was obtained, which on concentration gave a material with the following analysis:

| | | |
|---|---|---|
| Specific gravity | .. | 1·095 |
| Ascorbic acid | .. | 219 mgm./100 gm. |

No attempt was made to remove the pectic substances by enzyme action as the presence of pectin had been found, in previous work, both to aid the process of spray-drying and to assist in the retention of ascorbic acid. The concentrate was spray-dried in a semi-commercial Kestner machine. A smooth, free-flowing powder of very fine texture was produced without the slightest difficulty. Using an air outlet temperature of 85–90° C., a powder was collected which retained 5·1 per cent of moisture and 979 mgm. ascorbic acid/100 gm.—showing a negligible loss due to the drying process.

The powder was gas-packed in cans and after storage at room temperature for three months showed a loss of not more than 3 per cent in the ascorbic acid value. (The ascorbic acid determinations were carried out by the method of Harris and Olliver[1] and checked by the potentiometric method of Harris, Mapson and Wang[2].)

The hips used for the experiment were of poor quality, and very much higher figures should be obtainable with better samples of raw materials. It would appear that the production of such a powder might enable ascorbic acid to be added to certain solid food materials in this form.

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Sept. 8.

[1] *Biochem. J.*, **36**, 155 (1942).
[2] *Biochem. J.*, **36**, 183 (1942).

## Alleged Vitamin K Activity of Phthalic Acid

THE fact that several naphthoquinone derivatives and some related substances can replace the natural K-vitamins is most easily explained by assuming either: (1) that the prothrombinogenesis *per se* can be effected by several compounds, or (2) that the various vitamin K active substances are converted in the body into the same prothrombinogenic compound, which may be a substituted naphthoquinone.

Recently[1] it has been claimed that the vitamin K activity depends upon an oxidative biodecomposition of the suitably substituted naphthoquinones into phthalic acid. This compound was said to possess a perceptible although slight vitamin K activity, and the vitamin K activity of the 'diethyl ether' of phthalic acid was said to be high.

Potassium acid phthalate and diethyl phthalate have been tested for vitamin K activity in my laboratory. The method used was a modification of that of Dam and Glavind[2]; and the doses, fed to vitamin K-deficient chicks weighing about 300 gm., were 1, 10 and 100 mgm. potassium acid phthalate or 23 mgm. diethyl phthalate. The response was entirely negative. Under the same conditions menadione gave a considerable response in doses of 0·002–0·004 mgm.

Phthalic acid or diethyl phthalate can, therefore, not be the compounds which are responsible for the prothrombinogenic effect of naphthoquinones having vitamin K activity.

Whether substances showing vitamin K activity are converted by the animal body to phthalic acid is yet another question. At present, however, there seems to be little experimental evidence to support such a view.

This investigation was aided by the Josiah Macy, Jr., Foundation.

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Aug. 18.

[1] Shemiakin, M. M., Schukina, L. A., and Shvezov, J. B., NATURE, **151**, 585 (1943).
[2] Dam, H., and Glavind, J., *Biochem. J.*, **32**, 1018 (1938).

## Purification of Mares' Serum Gonadotrophin

IN 1941, Rimington and Rowlands[1] described the production from pregnant mares' serum of a concentrate having gonadotrophic activity of 150–625 I.U./mgm., depending upon the activity of the serum, and equivalent, in the mean, to 73 per cent of the activity of the starting material. The process is suitable for large-scale operation. Slight modifications, details of which will be published shortly, have resulted in about a two-fold increase in the activity of the product at this stage, without affecting the yield.

Further purification has been effected by fractional alcohol precipitation at varying *p*H. Comparatively inert material, to the extent of 80–90 per cent by weight, can be precipitated by 50 per cent alcohol over a *p*H range of 5·0 and 1·5; in more acid mixtures precipitation did not occur or was incomplete. The active material separates on increasing the alcohol concentration of the supernatant fluid to 66 per cent. The temperature was maintained at 0° C. throughout; no loss of activity occurred. The lower the *p*H of the mixture, to the limiting value of *p*H 1·5, the greater is the activity of the product. At *p*H 1·5 the products have assayed 11,750–12,500 I.U./mgm. and contain approximately 16 per cent hexose (orcinol method) and 8 per cent glucosamine. It was found that, whereas the hexose content of the products prepared at *p*H 1·5 and *p*H 5·0 respectively are in the ratio of 2 : 1, the ratio of their gonadotrophic activities is 12 : 1.

Experiments are proceeding to elucidate the chemical composition, electrophoretic behaviour and sedimentation velocity of our most highly purified preparations.

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Aug. 26.

[1] Rimington, C., and Rowlands, I. W., *Biochem. J.*, **35**, 736 (1941).

## Silicates of the Perovskite Type of Structure

THE mineral perovskite, $CaO.TiO_3$, is known as the prototype for the crystal structures of a large group of compounds[1]; the unit cell is essentially cubic, but for most members distorted to various degrees in an orthorhombic, monoclinic, or triclinic manner. Hitherto the composition $ABX_3$ has been regarded as characteristic of this structure, where $A$ and $B$ are metal ions of the total valency six, and $X$ is usually oxygen.

We wish to report that certain silicates also possess the perovskite type of structure, a fact which is believed to be new and of considerable consequence. They are merwinite, $3CaO.MgO.2SiO_2$ and its manganese analogue, $3CaO.MnO.2SiO_2$.

During the examination of basic electric arc furnace slags we found that a certain type differed in its X-ray diffraction pattern from the rest, and was closely related to perovskite. In contrast to normal finishing slags, this type had failed to 'fall' (that is, to disintegrate on cooling at 675° C through the transformation from β to γ-dicalcium silicate). The phases normally observed in falling slags, $\gamma$-$2CaO.SiO_2$, $3CaO.SiO_2$, $CaF_2$ and $MgO$, were absent from these samples; the absence of free magnesia in particular indicated that MgO would form an integral part of the new phase. The compound was identified as merwinite, dealing with which several publications have appeared recently[2,3].

The 'manganese-merwinite' was found by us by X-rays and is, to our knowledge, a new compound. It was obtained unexpectedly by firing 80 per cent $\beta$-$2CaO.SiO_2$ with 20 per cent $2MnO.SiO_2$ at 1,300° C. in hydrogen and cooling rapidly, in an attempt to determine whether a partial solid solution exists between these two compounds. The X-ray pattern of the fired product was the same as that of merwinite, but of a wider spacing. The composition of this phase is approximately $3CaO.MnO.2SiO_2$. The large $Mn^{++}$ ion possesses a radius nearly midway between that of $Mg^{++}$ and calcium ($Ca^{++} = 1{\cdot}06$, $Mn^{++} = 0{\cdot}91$, $Mg^{++} = 0{\cdot}78$ A.), so that it may also partly replace calcium, as is known, for example, in the garnets. The new compound attains a special significance, as it is liable to be produced in certain basic oxidizing slags.

The pattern of merwinite corresponds to a pseudo-cubic, but complex and somewhat distorted, unit cell, as revealed by the splitting of the main cubic lines into groups, and the appearance of additional reflexions. The lattice spacing of the ideal cube of merwinite is 3·76 A. against 3·81 A. for perovskite.

The fact of merwinite showing this type of structure seems important for the following reasons:

(1) The perovskite type of structure is highly accommodating in composition, and permits of a wide variation of relative and absolute ionic radii, without breaking down.

(2) No silicate of this structure type has, to our knowledge, been reported: a direct substitution in $CaO.TiO_3$ of $Ti^{4+}$ by the small $Si^{4+}$ ions (ionic radii 0·64 and 0·39 A.) would render the structure unstable (wollastonite $CaO.SiO_2$ differs entirely), but it becomes possible, if simultaneously some $Ca^{++}$ ions are replaced by the smaller $Mg^{++}$ or $Mn^{++}$ ions and certain lattice-positions are vacated.

(3) The structure is not, as usually regarded, tied to the formula $ABX_3$. Further evidence for this is afforded by perovskite itself. In the lime-titania binary system it was observed that $CaO.TiO_3$ and $3CaO.2TiO_2$ are isomorphous, except for a slight lattice-distortion, a generally permitted feature of the perovskite family. Apparently a series of solid solutions exists of CaO in $CaO.TiO_3$, extending beyond 60 molecular per cent CaO and modifying, but not destroying, the lattice. The mechanism is again one of omission of ions from the lattice. $Mg^{++}$ ions are also readily taken into solution. Thus, contrary to accepted ideas, the perovskite type of compounds may vary over a wide range of compositions from $ABO_3$ in the direction of and including $A_2BO_4$, covering merwinite if $Ca^{++}$ and $Mg^{++}$ are classed together.

The perovskite lattice consists essentially of a simple cubic lattice of Ca-ions with O-ions in the face-centres and Ti in the centre of the cube. The number of atoms per unit cell is $N = 5$. For merwinite, assuming the measured spacing 3·76 A., density 3·15 (value for natural mineral), mean atomic weight of $Ca_3MgSi_2O_8 = 23{\cdot}49$, calculation gives $N$ in the order of 4·3 atoms, in close approach to perovskite, but again indicating a more open lattice (vacant positions). It is necessary to add that the actual merwinite unit cell will consist of a multiple of perovskite cells. Nine such cells stacked in a pseudo-cube, and containing three molecules (42 atoms) would form the smallest unit able to take an integral number of merwinite molecules and will constitute a probable true unit cell. The detailed structure remains to be analysed. However, postulating the basic $SiO_4$ tetrahedral groups, as for all silicates[4], a line of approach lies in modifying the known perovskite lattice so as to accommodate these groups.

The chief practical point arising, apart from the existence of the two compounds as such, is probably the high tolerance factor of the perovskite type of structure, which implies that merwinite is able to take into solution a variety of radicals from contacting substances (slag, steel), provided the atomic sizes and valencies permit. In basic electric arc furnace slags, we have frequently observed variations in line-intensities and spacings of the merwinite pattern, which no doubt correspond to partial replacements, each involving a modification, but not a breakdown of the lattice. Merwinite may be considered as possessing a 'sponge-like structure' in which CaO, MgO, MnO, $SiO_2$, $TiO_2$ can be replaced within limits. Its influence on the properties of the slag is pronounced; the non-falling and hard constitution of slags found to be merwinite is one example.

We have observed by X-rays the presence of merwinite or its isomorphs not only in basic electric arc furnace oxidizing and finishing slags, but also in basic open hearth slags.

This investigation forms part of a more comprehensive research into the constitution of steel works' slags and refractories.

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[1] Goldschmidt, V. M., *Naturwiss.*, **14**, 477 (1926).
[2] Phemister, J., *Mineral. Mag.*, **26**, 225 (1942).
[3] Parker, T. W., and Nurse, R. W., *J. Iron Steel Inst.* (May 1943).
[4] Bragg, W. L., "Atomic Structure of Minerals" (Oxford University Press, 1937).

## Colour Microscopy in Ultra-Violet Rays

ULTRA-VIOLET microscopy has important advantages in the study of different microscopic objects[1]. In 1939 I suggested a new method of microscopy in ultra-violet rays, making use of selective absorption or reflexion of microscopic objects in the ultra-violet[2].

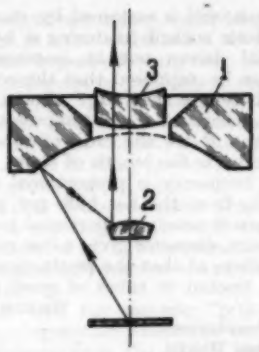
The first version of this method—the photographic one—is the following: a colour photomicrograph of a non-coloured object is taken in a way similar to that used in ordinary three-colour photography. The only difference is that to take the photograph three wave-lengths in the ultra-violet are used, whereas the reproduction of the three separation negatives is made with the help of the three primary colours in the visual, namely, red, green, blue. The hues of the details of such colour photomicrographs are given by the difference of densities of negatives taken in the ultra-violet, hence by the ultra-violet spectral absorption or reflexion curves for the corresponding parts of the object. The colours obtained are, of course, conventional; the image of the object is, so to say, shifted on the wave-length scale from the ultra-violet into the visible.

Some colour photographs taken in the way described are reproduced elsewhere[2,3]; they are illustrative of the possible applications of the method.

It is of great interest to construct instruments for direct colour vision in the ultra-violet without the use of the photographic methods. I have recently worked out and described two similar versions of a method for visual colour microscopy in the ultra-violet[3,4]. In the first, one each of the three ultra-violet wave-lengths excites one of the three primary colours on a fluorescent screen covered with a mixture of three substances, differing in the colour of their fluorescence, as well as in their excitation regions. In the second version, two rotating disks with three light filters each are used. Each filter of the first disk allows a certain part of the ultra-violet spectrum to excite a fluorescent screen and the corresponding filter of the second disk transmits one of the three primary colours of the white fluorescence excited.

The most essential part of the arrangement for colour vision and colour photography in the ultra-violet is the objective of the microscope. As is well known, it is not possible to realize achromatic objectives of large aperture for the ultra-violet with the use of the transparent lenses available for that region of the spectrum. Hence up to now only 'monochromat' objectives for monochromatic light had been devised by Rohr and Köhler[5]. The only attempt to use for this purpose the new reflexion optics was made recently by Johnson[6]. For colour microscopy, especially the visual kind, achromatic objectives are required. Therefore an objective of a new type based on reflexion optics (numerical aperture 0·50, $f = 6$ mm.) has been made by S. Gershgorin, P. Radchenko and myself following the suggestion of Gershgorin. The optical scheme is shown in the accompanying drawing. The reflexion objective, in contrast with the monochromat of Rohr and Köhler, allows the use of a broad spectral region; in consequence the arrangement is greatly simplified, more convenient light sources being used instead of the high-voltage spark of Köhler's microscope, and the expensive quartz monochromator being replaced by light-filters.

The method of staining of objects by organic dyes that are adsorbed on the tissues of the section, applied by biologists, is not highly selective enough and is usually characteristic only of a relatively large group of related substances. More refined investigations are made possible by the use of specific microchemical reactions that result in the formation of dye substances in the object itself. Unfortunately, most of the substances formed as the result of such reactions do not show any marked colour. Hence the search for microchemical colour reactions, especially for complex albumin compounds, is a difficult task. If, however, ultra-violet 'colours' typical for a great number of substances could be found, it is easy to visualize a new field of 'ultra-violet microchemistry', making use of the selective ultra-violet absorption of the products of the microchemical reactions. The development of this field which will follow the development and simplification of the microscope for visual observations in the ultra-violet will constitute an essential addition to the method of colour investigation of microscopic objects by means of the characteristic absorption of natural substances.




1, 2, MIRRORS; 3, FLUORITE LENS TO COMPENSATE FOR THE CHROMATIC ABERRATION OF COVER GLASS.

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State Optical Institute,
Leningrad.

[1] Martin, L. C., NATURE, **146**, 288 (1940).
[2] Brumberg, E. M., *C.R. U.S.S.R.*, **25**, 473 (1939).
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[4] Brumberg, E. M., *C.R. U.S.S.R.*, **31**, 658 (1941).
[5] Köhler, A., *Z. wiss. Micr.*, **21**, 273 (1904). Köhler, A., and Rohr, M., *J. Roy. Micro. Soc.*, **25**, 513 (1905).
[6] Johnson, B. K., *Proc. Phys. Soc.*, **53**, 714 (1941).

## Reverberation in Small Glass Tubes

A CASE of what at first seemed anomalous resonance has been found here in the course of blowing small bulbs on the end of capillary tubes of "Pyrex" brand glass. If a piece of capillary tubing of this glass of between 0·7 mm. and 4 mm. bore and about 8 cm. long is melted at one end and a bulb of about 1 cm. is blown, during blowing and afterwards the tube will be heard to emit a note the frequency of which depends principally on the diameter of the bulb but also on the stem length and the bulb temperature.

If the bulb is thick-walled, the note may continue for a minute or longer; or if the bulb is held in the flame at about 700° C. the note may be sustained indefinitely, or at least until the bulb collapses. While the note continues, an appreciable efflux of air seems to take place from the tube.

Evidently the oscillation starts in a way reminiscent of the troublesome oscillations which make Clement and Desormes' classical experiment on specific heat

ratios so difficult, and is sustained by reason of the fact that cold air sucked in during a half cycle is heated up and driven out at increased volume. Crudely, it may be supposed that the condition for sustained oscillation is that $\Delta T/T$ should be greater than $3r^3h/4R^3$, where $\Delta T$ is the temperature increase of the air, $r$ and $R$ are the radii of tube and bulb respectively and $h$ is the length of stem. It is probable that the frequency is proportional to the rate of heat transfer from the hot bulb per unit volume of air, and hence inversely proportional to the radius. A bulb of 20 mm. diameter gives a low note near the limit of audibility, so that the production of audible frequencies is limited to tubes of small dimensions.

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## Relation between Dissonance and Context

ACCORDING to Helmholtz's well-known theory[1], the consonance or dissonance of a chord depends on the extent to which its component fundamental tones and their overtones produce beats. Even a cursory study of the methods of musicians, however, and the experience of listening to music, make it seem possible that in actual practice the degree of harshness of dissonances varies considerably according to the way in which they are used and on their context of surrounding chords. A short experiment was planned to test this possibility.

A set of twelve dissonances was devised, of varying harshness and complexity, and each was provided with six different contexts or settings. Each setting consisted of two chords, one before and one after the test chord. In settings *A* and *B* a variety of chords were employed which had been chosen in the hope that they might produce some effect on the degree of dissonance of the test chord; in settings *C* and *F* the test chord itself was simply transposed one tone in sequence, passing the test chord downwards in set *C*, and, with otherwise identical notes, upwards in set *F*; in settings *D* and *E* arbitrarily chosen chords were employed, passing from complex combinations through the test chord to simple combinations in set *D*, and using the identical sets of chords taken in reverse order in set *E*.

The subjects of the experiment were forty-eight students who had some experience in psychological laboratory work; there were forty women and eight men. They were asked to listen to the groups of chords, which were played on the piano in the order *A* 1 to 12, *B* 1 to 12, and so on, and to assess the dissonance of the middle or test chord of each group on a scale ranging from − 3 (very dissonant) up to + 3 (very consonant). They did not find any difficulty in the task. It seems odd that positive assessments were used, though less freely than negative, but this is understandable to us, because, though all technically dissonances, some of the test chords formed very sonorous clangs of sound, and this may be one way in which Helmholtz's theory tends to break down. Two trial sets of chords were used to explain and demonstrate the aim and technique of the experiment to the subjects, and it was made clear that the experiment was not concerned with liking and disliking but only with consonance and dissonance.

The assessments for each chord in each of its settings were converted into scores by multiplying the totals by the corresponding ranks. Correlations were then worked out by the product-moment formula between the scores for each chord in settings *A* and *B*, *C* and *F*, and *D* and *E*. This gave thirty-six correlations, of which, according to the technique explained by Fisher[2], eight differed significantly from zero. These correlations are shown in the accompanying table. If there were no factor at work tending to make the chords sound equally dissonant (or consonant) whatever their context, we should expect no positive correlations. If there was a strong factor tending to make them sound quite different according to the context although they were the same chords, we should expect a large proportion of negative correlations. The fact that we find a small proportion of positive correlations enables us to draw the inference that there is some tendency for the chords to maintain their dissonance- (or consonance-) levels in spite of their changing contexts, but that those contexts have a very marked effect on the chords, tending to alter their level of harshness. The same conclusion is reached from the small magnitude of the correlations, only two of which were above 0·6.

| Chord number | Pairs of settings correlated and probability of correlations | | | | | |
|---|---|---|---|---|---|---|
| | *AB* | *p* | *CF* | *p* | *DE* | *p* |
| 2 | 0·50 | <0·01 | 0·56 | <0·01 | — | — |
| 6 | 0·48 | 0·01 | — | | 0·46 | 0·02-0·01 |
| 9 | 0·45 | 0·02 | 0·50 | <0·01 | — | |
| 10 | 0·61 | <0·01 | — | | — | |
| 11 | — | | 0·65 | <0·01 | — | |

From these data it must be inferred that the dissonance of a chord depends even more upon the relation in which it stands to its surrounding chords than on the nature of the chord itself. The objection might be raised that the subjects were simply judging the dissonance (or consonance) of given chords in comparison with more (or less) dissonant chords on either side of them. This objection, however, is met by the results for settings *C* and *F*, which consisted of the test chord itself, transposed one tone up or down. In these settings there should, on the usual theory, be no contrasts of dissonance at all. It is perhaps surprising that settings *D* and *E*, which were arbitrarily chosen, should have produced fewer correlations than either *A* and *B* or *C* and *F*. It is clear that the experiment should be repeated with more adequate material composed by an experienced musician.

We are indebted to Mr. Joseph F. Simpson for calculating the correlation coefficients.

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[1] Myers, C. S., "A Text-book of Experimental Psychology" (3rd Ed.), Pt. 1, 52–55 (1928).
[2] Fisher, R. A., "Statistical Methods for Research Workers" (8th Ed.), 186–187 (1941).

## A Y-linked Inheritance of Asynapsis in *Rumex Acetosa*

GENICALLY inherited asynapsis is sometimes met with in a number of plant species, according to observations made by various workers during the last ten years. The most remarkable cases were recently reviewed by Prakken[1]. In a number of the cases observed it was, however, not possible to say with any certainty if the lack of chiasmata at meiosis really was genically determined or not. One of these

uncertain cases was observed by Yamamoto[3] in a Japanese male plant of *Rumex Acetosa*, but in *Rumex angiocarpus* I observed[2] asynapsis, which most possibly is of the modificatory type.

In the spring of 1939 I obtained a morphologically normal male plant of *Rumex Acetosa* ssp. *pratensis* from a locality in south-east Sweden. This plant was found to be characterized by a high degree of asynapsis. Although the pollen was almost completely sterile, a progeny was raised by crossing this individual with normal female plants from other localities. The high degree of asynapsis was also met with in all the male individuals of these progenies. The males were highly sterile, but the females were completely normal with a good seed setting.

As the first generation clearly showed that the asynapsis was genically caused, closer analyses of the inheritance of this disturbance were made. These analyses showed that the character is only met with in the male plants. This might, theoretically, be due to *Y*-linked inheritance or—as the number of male plants in the $F_1$ generation was as low as only six individuals—an *X*-linked recessive character. Closer analyses of the female hybrid individuals showed, however, that they were completely free from the gene for asynapsis. The cross hybrid female × normal male gave only normal males and females, the cross hybrid female × asynaptic male gave asynaptic males and completely fertile females, and these latter females crossed with a normal male also gave only completely normal males and females. On the basis of these results I regard it as most plausible to consider it as definitely demonstrated that the asynaptic gene in this material of *R. Acetosa* is located in one of the two *Y*-chromosomes.

According to Ono[4], Yamamoto[3] and others, the *Y*-chromosomes of *R. Acetosa* are completely inert as to sex-determining genes. The *Y*-linked inheritance of asynapsis in the present material shows, however, that the *Y*-chromosomes are not completely without genes.

A *Y*-linked inheritance of genes other than sex-genes has been previously observed in some few animals, but in plants only a gene suppressing the manifestation of an autosomal gene for 'variegated leaves' in Melandrium may, according to Winge[6], possibly be regarded as completely *Y*-linked.

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Aug. 5.

[1] Prakken, R., *Hereditas*, **29**, 475 (1942).
[2] Yamamoto, Y., "Botany and Zoology", **2**, 1160 (1934).
[3] Löve, A., *Hereditas*, **30**, 1 (1944). (Diss. Lund, 1943).
[4] Ono, T., *Sci. Rep. Tohoku Imp. Univ.*, Ser. 4, **10**, 41 (1935).
[5] Yamamoto, T., *Mem. Coll. Agric. Kyoto Imp. Univ.*, **43**, 1 (1938).
[6] Winge, Ö., *Hereditas*, **15**, 127 (1931).

## Adult Education in Science

IN view of the attention now being given to the replanning of educational systems, experiences gained in Salisbury may be of value in directing adult education of the future along needed lines.

Initially, in 1940, an attempt was made by a number of university teachers to enable junior technical assistants of a Government establishment to complete gaps in their basic scientific training and so be able to continue their studies with greater facility at the end of the War. As time passed, however, it was found that enthusiasm was such that courses on advanced topics could be given successfully. These at once attracted a number of senior workers, who expressed the view that the more advanced discussions, particularly of rapidly developing subjects such as biochemistry, or molecular theories, were of great value to specialists, who feared that their outlooks might be becoming unduly stereotyped since, in many cases, their basic training had been imparted years ago.

I feel that this venture at adult scientific education in war-time is not only a success, but also that it is probably indicative of a widespread latent demand for more detailed information about recent scientific achievements.

It suggests that my pre-war "popular lectures" delivered, in conjunction with social service organizations, on "Science from the Easy Chair" lines were fundamentally misdirected efforts, and that the true function of adult education should be to keep alive, and develop, the enthusiasm for knowledge of those who realize the cultural dangers of specialized occupations, rather than to attempt to arouse faint interests when initiative is lacking.

Few, if any, other countries have so large a proportion of skilled technicians who, in the course of their daily work, have to become extreme specialists with but little opportunity to learn, once their basic training has been completed, even the broad lines of development of scientific thought, or to hear of modern discoveries of interest. Yet to many such specialists (witness those in the light electrical or textile industries) there may well come a time when fundamental scientific advances bring about the derangement of the whole of their prospects of beneficial employment.

If the adult education movement can enable technicians in industry to keep abreast of modern trends of scientific thought, it will be playing a more vital part in the life of the community than if, as at present, it is thought of as an 'escape' from a mechanized age. Unfortunately we are, in Great Britain, tending to mechanize science to the community by not disseminating widely enough the most modern scientific conceptions as they progressively develop in the light of new research.

A few public lectures in big cities, stimulating though they may be, are not enough. There are needed also planned courses at which are discussed current ideas which stimulate scientific thought and new discoveries of significance.

W. A. WATERS.

Salisbury. Aug. 8.

## Archæology as a Science

IF all archæologists were of the calibre of Prof. Gordon Childe I could heartily endorse his opinions regarding the scientific status of archæology. But, alas, this is not the case, though no one, I hope, has a stronger belief in the value and importance of archæology, both from the 'historical' and philosophic points of view, than I possess. Prof. Childe quotes as one of the methods of archæology "dispassionate observation". This desirable quality, which I understand is somewhat uncommon in any science, is not, I should have thought, exactly an outstanding characteristic in archæological circles. That, indeed, is my conclusion after many and sometimes exacting years of experience.

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# RESEARCH ITEMS

### Archæological Survey of Pickwick Basin, U.S.A.

WHEN the dam at Pickwick Landing on the Tennessee River near Savannah was projected it became obvious that unless an archæological survey of the district was undertaken before the neighbourhood was 'drowned' much important information would be lost (Smithsonian Institution, Bureau of American Ethnology, Bull. 129. "An Archæological Survey of Pickwick Basin in the Adjacent Portions of the States of Alabama, Mississippi and Tennessee." By W. S. Webb, D. L. Dejarnette and others). Some nineteen sites were studied. Several of these showed the copper-galena complex of traits which connect them with other excavations in the Wheeler Basin. It would not appear that anything startlingly new has turned up, but an interesting series of flint implements, pottery and burials has come to light. These regional surveys will, of course, supply the material for a comprehensive account of prehistoric times in the U.S.A. when eventually the time is ripe for such a work to be projected.

### Human Bartonellosis

IN a recent paper (*Bol. Of. San. Panamericana*, 22, 304; 1943) Dr. B. Mera of Colombia states that human Bartonellosis is an infectious disease of the most peculiar and constant epidemiology, manifested by fever and anæmia, by a typical skin eruption or by a combination of all these manifestations. The causal agent is *Bartonella bacilliformis*, a Gram-negative organism which is pathogenic for man and *Macacus rhesus*. Three foci of Bartonellosis exist at present in America, namely, in Peru, Ecuador and Colombia. In Peru, *Phlebotomus verrucarum* is the chief vector of the disease, while in Colombia several phlebotomi have been found, but the most responsible is still unknown. The only proved reservoir of the infection is the infected man with apparent or inapparent infection. The blood and reticulo-endothelial system are the structures most affected. At the present time the only effective means of control is by personal protection.

### Relative Potency of Carcinogenic Hydrocarbons

SINCE the discovery of the carcinogenic action of 1 : 2 : 5 : 6 dibenzanthracene, 3 : 4 benzpyrene and 20 methylcholanthrene, these hydrocarbons have been used in laboratories in all parts of the world. It is often thought that methylcholanthrene is the most active, and dibenzanthracene the least active, of the three compounds. A thorough analysis of the sarcoma-producing action of the substances in mice has now been made by two American workers, Dr. W. R. Bryan and Dr. M. B. Shimkin (*J. Nat. Cancer Inst.*, 3, 503; 1943), using the statistical methods developed by Gaddum, Bliss and Irwin. The results show that although methylcholanthrene is the most rapid and dibenzanthracene the slowest in action of the three hydrocarbons, tumours are eventually produced with smaller doses of dibenzanthracene than of the other compounds. Much larger doses of benzpyrene are required for sarcoma production than in the case of either of the other substances. The experiments show conclusively that carcinogenic action follows the usual dose–response relationship found in other pharmacological actions. The probit of the tumour incidence is proportional to the logarithm of the injected dose over a fairly wide range of dose levels.

### Protein Hormones of the Pituitary Gland

A VERY useful survey of our knowledge of the protein hormones of the pituitary gland is given in *Annals of the New York Academy of Sciences*, 43, pp. 253–426 (Feb. 1943). Criteria of purity of these proteins such as crystalline form, homogeneity from electrophoretic, centrifugal, sedimentation and solubility measurements as well as constancy of biological activity are discussed. It is pointed out that if the biologist and physical chemist can agree as to what fraction of a preparation is "the substance" and what "the impurity", then the evidence from the physical chemist provides the best criterion of purity within the limitations of the experimental methods. Whether the pressor and oxytocic activities of the posterior lobe reside as an integral part of one large molecule, and the separate principles may be produced by cleavage of the mother molecule during extraction and purification; how far the chemistry has progressed of the anterior pituitary follicle stimulating luteinizing and lactation-initiating hormones, the latter, of course, prolactin, being the first pituitary hormone to be obtained in the pure state; the existence of "mammagen", the factor concerned with the growth and development of the mammary gland—these are some of the points on which evidence is reviewed and present theories are discussed.

### Osteology of the Louvar

A DESCRIPTION is given of the skeleton of this fish by William K. Gregory and G. Miles Conrad (The Osteology of *Luvarus imperialis*, a Scombroid Fish: A Study in Evolution. *Bull. Amer. Mus. Nat. Hist.*, 81, Art. II, 1943). The specimen was caught off Cayo Corton Island, Florida, and weighed 200 lb. This is a rare pelagic fish, descending to considerable depths; it seeks its food, in all probability small planktonic organisms, by night, the mouth being small and the jaws without teeth. Its larval stages are exceedingly interesting, the fish undergoing several 'hypermetamorphoses' before attaining the adult form. The main plan of the skeleton consists of three longitudinal supports formed by the backbone and the interlocking bases of the dorsal and anal fins. The tail is large and powerful, with a specialized pivot vertebra at its root, permitting a wide sweep. The brain case is specially strengthened just in front of the first vertebra by extremely dense parts which receive the thrusts of the locomotor system. Otherwise the skeleton is delicate and fragile. The study is a detailed one and the figures are very well executed. There is a full discussion and summary of the structural and functional characters and of the phylogeny and classification.

### Pedigrees of Polydactylism

IN more recent times the literature provides pedigrees of polydactylism in a few distinct families over a few generations. J. M. Odiorne (*J. Hered.*, 34, 45; 1934) has collected data in families all descended from a settler in New England in 1644. The pedigree involves ten generations and ninety polydactylous individuals who have an extra finger or toe on one at least of their extremities. The character is believed to be dominant with highly variable expression and penetrance. One wonders whether this weak penetrance observed in some human characters is not a result of polyploid interaction, as in the dahlia.

### Dental Malocclusion in the Quintuplets

N. Ford and A. D. Mason (*J. Hered.*, **34**, 57; 1943) show that heredity is an etiological factor in malocclusion, in which the jaws do not fit perfectly. Moulds of the dentition of the quintuplets have been taken annually and the time of eruption of the teeth noted. There was a difference of 25·8 per cent between pairs of quintuplets and 60 per cent between individuals in a population in regard to the order and time of eruption of the permanent teeth. This together with other evidence indicates that heredity plays some part in the formation of the jaws. A predisposing cause in the production of malocclusion appears to be the relative time of eruption of both temporary and permanent teeth.

### Inefficiency of Iron Utilization

Soya bean varieties differ in their ability to grow normally in low iron concentrations. M. S. Weiss (*Genetics*, **28**, 253; 1943) has found that some varieties grow normally in low-iron cultures whereas others show iron chlorosis and finally die. On the basis of $F_2$, $F_3$ and backcross progenies between efficient and inefficient varieties, the author shows that one recessive gene *fe* causes inefficiency and iron chlorosis. Physiological effects of *fe* are higher *p*H, low-soluble iron, high total iron and low potassium contents.

### Witches' Broom Disease of Cacao

The cacao crop in Trinidad and Tobago is menaced with a serious witches' broom disease caused by the fungus *Marasmius perniciosus*. R. E. D. Baker and S. H. Crowdy (Mem. No. 7 Imperial College of Tropical Agriculture, Trinidad, B.W.I.; January 1943) have studied the symptoms and ecology of this malady, and their results are of interest to the general mycologist as well as to the plant pathologist. The fungus can attack vegetative shoots and flowering cushions of the cacao tree, giving variable symptoms. Sporophores are never produced upon green brooms, and only appear on dry brooms after five or six months. A short drought followed by heavy rain brings ideal conditions for sporophore production, and they may appear over a period of two years. Long periods of drought and continuous rain both have a depressing effect upon the appearance of fruit bodies, though they are generally more numerous in the wet season. The fungus is amenable to pure culture on several media, but no fructifications are then formed, even though the organism is homothallic. Spores are liberated mainly at night, when temperatures fall to between 85° F. and 57° F.; their ability to cause the disease has been demonstrated by successful inoculation with pure cultures. Infection with mycelium appears to be incapable of inducing the malady. This fact greatly facilitates control, since brooms removed from infected trees in May and October need not be collected and burned. They are innocuous if left scattered upon the ground.

### A Tuned Null Detector

An article by F. B. Anderson (*Bell Lab. Rec.*, **21**, No. 10; June 1943) describes a new tuned null detector which has been designed to eliminate volume adjustment entirely, compressing a volume range of over 100 db. into a variation of the reading of a simple milliammeter, and reducing tuning to a very simple operation that does not require the use of calibration charts or curves. The basic element of the volume-control circuit is a pentode feedback amplifier with an input-output characteristic in which, for inputs less than 40 db. below one milliwatt, the plate current remains essentially constant at its maximum value, but as the input increases above −40 dbm., the plate current decreases, becoming essentially zero at an input of 0 dbm. This characteristic is secured by connecting a diode rectifier between the plate and grid in such a way that as the input increases above −40 dbm., a certain portion of the plate current, rectified by the diode, will increase the negative bias of the control grid and thus reduce the plate current. The grid-to-plate voltage gain in the region of 0 dbm. input approaches unity, so that several stages may be cascaded for input ranges in excess of 40 db. The detector is designed for operation at 1 kc. or at any frequency between 3 and 150 kc., and to permit the single tuning control to act over this entire range, an eleven-point six-gang switch is provided that divides the total frequency range into sub-ranges by switching in different sets of coils and condensers in the output circuit of each stage. The detector may be operated close to the driving oscillator without experiencing cross-talk. The sensitivity is about the same as that obtainable with earphones and a heterodyne operating at its highest sensitivity. The simple tuning and the complete freedom from volume adjustments obtained in this detector make it a measuring instrument that is decidedly superior to the auditory method under many conditions.

### Resolution of the Telluric Bands $\omega_1$ and $\omega_3$

A short note by A. Adel (*Astrophys. J.*, **97**, 190; 1943) announces the resolution of the carbon dioxide bands at 2·01 μ and 2·05 μ in the solar spectrum. The rotational structure of the bands is clearly revealed, the separate lines being so much as 6 A. apart since alternate lines are forbidden by the selection rules. The rotational distribution corresponds to a mean temperature of −18° C. for the carbon dioxide mass above Flagstaff, Arizona, at noon in January.

### Configuration of Glycosides and Sugars

A new method for determining the configuration of glycosides and sugars, depending on the alkaline degradation of phenylglycosides, is described by E. M. Montgomery, N. K. Richtmyer and C. S. Hudson (*J. Amer. Chem. Soc.*, **65**, 3; 1943). It was found that β-phenyl-*D*-glucoside and β-phenyl-*D*-galactoside are readily degraded by the action of hot aqueous potassium hydroxide to *D*-glucosan <1,5>β<1,6>, and *D*-galactosan <1,5>β<1,6>, respectively, while α-phenyl-*D*-glucoside was unaffected and α-phenyl-*D*-galactoside was attacked only very slowly under considerably more drastic conditions. The action of hot alkali on aromatic glucosides has long been known to cause hydrolysis, but most investigators seem to have assumed that the non-phenolic product was either glucose or its decomposition products. It is pointed out that the reactions studied resemble the anhydride formation in *cis*- and *trans*-dicarboxylic acids, and a similar relation to the groups in the glycosides leads to the same configurations as those previously assigned on other grounds.

# ROYAL SOCIETY OF CANADA

## ANNUAL MEETING

THE annual meeting of the Royal Society of Canada was held at McMaster University, Hamilton, Ontario, during May 25–27. The scientific sections of the Society held their meetings in the Science Building of the University and the general meetings took place in Convocation Hall. The president of the Society, Prof. J. B. Collip, presented the medals at the evening meeting on May 25. The Flavelle Medal was awarded to Prof. B. P. Babkin, research professor of physiology at McGill University, for his outstanding work in analysing the secretory mechanisms of the digestive glands. Prof. John L. Synge, professor of applied mathematics in the University of Toronto, received the first award of the Henry Marshall Tory Medal for outstanding contributions to applied mathematics; and the Willet G. Miller Medal, also awarded for the first time, was presented to Prof. Norman Levi Bowen, distinguished service professor of petrology in the University of Chicago, in recognition of his contributions to geology. Following the presentation of the medals, Dr. Collip read his presidential address on "Science and War". After briefly reviewing the part played by science in former conflicts, Dr. Collip emphasized the important contributions of physicists, chemists and other men of science in the present War. He dealt in some detail with aviation medicine and the co-operation between the men of science and the armed forces in solving many of the problems which modern warfare presents. He referred to the recognition and support that scientific workers are now receiving as an integral part of the war effort, and pointed out that much of this research work is producing results that will be equally important in the post-war period.

A further feature of the meeting was the symposium, held after the dinner on May 26, on "Medical Investigations as Applicable to the Armed Forces", at which Surgeon Captain A. McCallum, medical director-general of the Royal Canadian Navy, spoke in general terms of the organization for research in this service and of the work already accomplished. Surgeon Commander C. H. Best, director of the Royal Canadian Naval Medical Research Unit, gave a more detailed account of some of the results achieved in connexion with nutrition, night-vision and similar problems. Brigadier J. C. Meakins outlined briefly the medical research going on in the Army, and Group Captain J. W. Tice, director of Medical Services (Air), spoke of some problems of interest to the Air Force in particular. This was followed by Squadron Leader K. A. Evelyn, who discussed in further detail many of the special problems in aviation medicine, at the conclusion of which he showed a special moving-picture film entitled "Oxygen". This film was shown as a feature, permission for which had been specially granted. It was prepared under the auspices of the Associate Committee on Medical Research of the National Research Council for use in training enlisted aircrews in the essentials of physiology and the effects of high-altitude flying, pointing out the importance of the special precautions required.

Prof. J. K. Robertson delivered the presidential address in Section III (Chemical, Mathematical and Physical Sciences) on "The Role of Physical Optics in Research", in which he reviewed the discoveries into the nature of light, atomic and molecular structure and in astronomy which have resulted from the application of physical optics in spectroscopy, interferometry and diffraction. This historical account was followed by an address on "Chemical Reactions of Excited Atoms" by Dr. E. W. R. Steacie, and a paper on "Molecular Spectra and their Applications" by Dr. Andrew McKellar, who spoke particularly of applications in astronomy. Thirty-eight papers were presented to the section, the majority of which were read by title. Owing to the pressure of war work, few physicists and chemists were in attendance, but mathematics and astronomy were well represented. Among those papers which were read, mention may be made of a few of some general interest. Prof. Lachland Gilchrist and J. W. Britton gave an account of further experiments on the use of drill holes in electrical methods as an aid to the location of mineralized bodies and rock structure. Dr. J. A. Pearce announced the orbital elements of *H.D.* 222107 λ Andromedæ as revised on the basis of recent measurements and also the orbital elements of the spectrographic binary *H.D.* 34333. A paper of particular interest was given by Dr. L. M. Pidgeon on the production of light metals, in which he reviewed the methods for the separation of magnesium and the difficulties which had to be overcome. He gave an account of his own experiments, which resulted in the present method used in obtaining large quantities of magnesium metal in Canada since the outbreak of hostilities. Dr. H. F. Manske and L. Marion reported the isolation of eight alkaloids from *Lycopodium annotium* L. Several papers were presented by Dr. Paul E. Gagnon and his co-workers, among which mention may be made of one in which the isolation of some new sulphamides was announced. Perhaps the most interesting paper presented to the section was one of those given by Prof. E. F. Burton, in which J. H. L. Watson showed how stereoscopic photographs had been taken with the electron microscope, and exhibited several examples. This new technique enables one to view the objects photographed so as to bring them out in three dimensions, thus adding depth to the pictures and revealing new features in the structure of smoke and metallic particles. At the conclusion of the sectional meetings, Prof. T. Thorvaldson was elected president of the Section for the year 1943–44.

In Section IV (Geological Sciences), Prof. M. B. Baker gave the presidential address and spoke on "Gold and Iron Prospects in Canada". This address was followed by sixteen papers on various geological investigations. Among these, Dr. E. A. Hodgson delivered a very interesting paper on the "Rock Burst Experiments at Lake Shore Mines, Kirkland Lake". He outlined the programme of the investigations carried out since 1939 and gave some of the results already obtained. Equipment has been designed to pick up, amplify and record the small subaudible snaps which occur in a rock under pressure and which increase in number as the pressure increases. The records of a severe rock burst which occurred on January 29, 1943, show conclusively that the method clearly delimits the area under pressure to within a hundred feet or less. So far, attempts to predict bursts as to time have not been successful; but it is hoped that further work will result in some measure of time prediction.

Prof. G. B. Reed, president of Section V (Biological Sciences), spoke on "Wound Infections and Local Chemotherapy". This paper dealt with the treatment of wounds with the sulpha drugs and emphasized the necessity of applying the drug as soon as possible

after the wound had been inflicted in order to obtain the greatest benefit. Fifty-six papers were presented to this Section, many of which will appear in scientific journals. Space permits the mention of the two invited papers only. That by Dr. Babkin, on "Secretory Mechanism of the Digestive Glands", contained a survey of the work of his laboratory on this subject. Briefly, it may be stated that the investigations have established that the mucous, demilune and myo-epithelial cell groups of the submaxillary gland each have a separate innervation, and that the surface epithelium cells of the gastric mucosa and the mucoid, peptic and parietal cells of the gastric glands are under independent nervous or humoral control. The conclusions to be derived from this work were stated and further analysis of the secretory function of the digestive glands given. The second paper, by Prof. G. W. Scarth on "The Mechanism of Frost Resistance", contained an account of the modes of frost injury to plant cells and of the protoplasmic changes which accompany frost-hardening. He also discussed how the different hardening changes afford protection. The new president of this Section is Prof. H. S. Jackson.

At the general meeting, Monsignor Olivier Maurault, rector of the University of Montreal and a fellow of Section I, was elected president of the Society, and Prof. J. K. Robertson was elected vice-president.

DAVID A. KEYS.

## HERMIT CRABS FROM THE JOHN MURRAY EXPEDITION

DR. E. F. THOMPSON has published some interesting facts in the report referred to below* of collections obtained by the John Murray Expedition. The stations at which the Pagurids were taken are confined to the Gulf of Oman, the south Arabian coast, the Gulf of Aden, the East African coast, the Zanzibar region and the Maldive area, that is to say to the coastal regions and the two Gulfs.

The littoral and shallow-water forms are related to those of the rest of the Indo-Pacific region. The deep-water forms may be divided into those living at mid-depths, which have considerable affinity with those of the North Atlantic, and the only truly abyssal form *Parapagurus pilosimanus*, which occurs at great depths around the edges of every ocean basin in the world. Nothing is known of the life-history of this species. It has always been recorded as housed in a typical zoophyte growth. In the present collection this was not the case; a number of different shells were used, the most frequent being Ianthina. The zoophyte house begins around a shell, and the author has found in two specimens examined from the North Atlantic that this basis was also on Ianthina.

*Paguropsis typica*, hitherto only known from the Philippines, the Gulf of Martaban and Cape Comorin, was found in the Zanzibar region, thus extending its known distribution another 2,000 miles round the world. Its range in depth is only 32 metres, although its geographical distribution is so wide.

The one new species described is a Sympagurus, *S. burkenroadi*. The suggestion that the three specimens of Glaucothoe, attributed to *G. hendersoni*, found in the collection may be the larvæ of *S. burkenroadi* is most interesting. Whether the large symmetrical deep-water pagurids known as Glaucothoe are adults or larvæ is now practically settled in favour of the latter view, but it is still a matter of controversy as to whether they are abnormal or normal larval forms—the larvæ of small pagurids which have failed to find a shell and consequently have continued to grow in a larval state, or merely natural larvæ of large forms. The latter solution appears most likely to be the correct one, and Dr. Thompson has brought the matter further by finding these Glaucothoes inhabiting shells, with the abdomen twisted, but still with paired abdominal appendages and a symmetrical tail fan. Thus they are further developed towards adult pagurids than any specimen previously recorded. If they are normal larvæ, they must belong to large adults. In the present case the adult is very probably a Sympagurus, and the characters, except for those which are purely larval, agree very closely with those of *S. burkenroadi*. Moreover, one was found inhabiting the same species of shell. We are certainly well on the way to solving the 'Glaucothoe problem'.

* Paguridæ and Coenobitidæ. By Dr. E. F. Thompson. (The John Murray Expedition 1933–34, Scientific Reports, 7, No. 5, 1943.) (London: British Museum (Natural History).)

## HIGH CRYSTAL HARMONICS FOR OSCILLATOR CONTROL

AN article on this subject by I.E. Fair (*Bell Lab. Rec.*, 21, No. 8; April, 1943) points out that stability is one of the major requirements for oscillators controlling the frequency of radio transmitters. In ultra-high-frequency transmitters it assumes particular importance because a very small percentage change in the frequency of the controlling oscillator may shift the transmitted band many thousands of cycles. At 100 mc., for example, a 0·01 per cent change in frequency means a change of 10 kc., which is as much as the entire width of a broadcast band. Stability in oscillators is secured by some form of tuned circuit. The reactance of such a circuit changes slowly with frequency except over a narrow band in the region of resonance, where a small change in frequency is accompanied by a very large change in reactance, this latter enabling the resonant circuit to act as a frequency stabilizing element. Quartz crystals are eminently suited to control in this way because of their very sharp resonance, which is due to their low values of coupling and dissipation. Their characteristics change only slightly with variations in temperature and voltage, and thus high stability under all conditions is more easily obtained with them than with elements having higher dissipation or greater sensitiveness and voltage.

With the type of crystal most commonly used for oscillators, the frequency of resonance is inversely proportional to the thickness of the crystal. At 10 mc., for example, the thickness of the crystal is only about 6½ thousandths of an inch. Before being used in an oscillator, the crystal must be ground accurately to have parallel faces and to the desired thickness; satisfactory grinding becomes impracticable for crystals appreciably thinner than this. For transmitters requiring higher frequencies it has been almost universal practice to use a crystal with its fundamental resonance below 10 mc. and to employ a harmonic generator to secure the desired high frequency. So far as stability is concerned, this method is satisfactory, but it requires a very appre-

ciable amount of additional apparatus. Not only does the cost of the oscillator go up, but the size also increases, and for many of the high-frequency applications, space is at a premium.

Practically all the circuits used for quartz crystal oscillators require that the reactance of the crystal be positive at the operating point. While harmonics of the fundamental crystal frequency may be used with this type of circuit, therefore, only those giving a positive reactance are possible. Oscillators for a large part of the ultra-high-frequency range have thus been forced to employ harmonic generators, since the 5th harmonic of the thinnest usable crystal is only about 50 mc. This situation has now been changed by a circuit developed in these Laboratories and described in the article, which permits crystal harmonics at least as high as the 23rd to be used for direct control of an oscillator circuit. Oscillators have been built for frequencies as high as 150 mc., using crystals with fundamental frequencies below 10 mc.

## SINHALA WEAPONS AND ARMOUR

THE *Journal* of the Ceylon Branch of the Royal Asiatic Society for December 1942 contains an article by P. E. P. Deraniyagala on "Sinhala Weapons and Armor". The work of the Sinhalese armourers seems to have elicited great praise from Europeans of the seventeenth century, but one may legitimately doubt whether tempering swords in blood or milk made them any better as weapons, unless it were that they gave greater confidence. The Sinhalese court went in, apparently, for gladiatorial shows; fencing was taught, and foils (or singlesticks) were used in mock combat. The weapons illustrated include the boomerang, both of horn and of wood, and it is worth noting that the Koli name for it is *katariya*: very suggestive of the Latin name for it—*cateia*. The prevalence of the leaf-shaped sword is striking. It is interesting to find in use the feathered javelin, if one can so describe it when the 'feather' was made of metal. Possibly the flat metal vanes were derived from vanes of pandanus leaf such as are used both for crossbow bolts and for javelins in the Assam hills.

A javelin feathered like an arrow appears in the hand of a god or hero in one of Titian's paintings, and Barbosa depicted a similar weapon in the hand of the King of Cochin riding on his elephant; some Eskimo harpoons are so constructed, but the type is a rare one. The author's description of a Sinhalese blowgun is tantalizing. Since he describes it as a wooden tube, it is presumably bored from wood in a single piece. Blowguns of this kind are rarely so long as 80 in. except in Borneo. The tube is tapered, and we are told that "the poisoned dart was fixed with a lump of clay" at the nozzle and propelled by blowing up the tube from the other end, which sounds highly improbable, not to say inefficient. A detailed account of these blowguns, their use and manufacture, of the darts, and of the poison used is much to be desired, as well as some account of the toy blowguns which we are told are still in use. Some of the other descriptions also leave much to be desired. The illustrations are good, but the author is probably wrong in describing Plate I, *b*, as representing wrestlers; the left-hand figure appears to be female and the other to be seated. In general, however, the article contains a useful and well-illustrated account of antiquated Sinhalese weapons.

J. H. H.

## FORTHCOMING EVENTS

### Saturday, September 25

BRITISH PSYCHOLOGICAL SOCIETY (at Tavistock House, Tavistock Square, London, W.C.1), at 2.30 p.m.—"Education of the Adolescent".

INTERNATIONAL COMMITTEE FOR BIRD PRESERVATION (BRITISH SECTION AND POLISH SECTION) (at the Royal Geographical Society, Kensington Gore, London, S.W.7), at 2.30 p.m.—Dr. Jul. Borucki: "The Future of Bird Preservation in Poland"; Mr. Walter E. Higham: "British Featherland" (colour film).

### Tuesday, September 28

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 4.30 p.m.—Prof. A. F. C. Pollard: "A Proposed Institute of Information".

SHEFFIELD METALLURGICAL ASSOCIATION and SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS (at the Royal Victoria Station Hotel, Sheffield), at 6.0 p.m.—Sir Lawrence Bragg, F.R.S.: "The Strength of Metals".

### Wednesday, September 29

MANCHESTER METALLURGICAL SOCIETY, THE INSTITUTE OF METALS and THE IRON AND STEEL INSTITUTE (at the Engineer's Club, Albert Square, Manchester), at 6.30 p.m.—Dr. W. H. Taylor: "Lattice Structures in Relation to Physical Properties of Metals".

### Friday, October 1

ASSOCIATION OF APPLIED BIOLOGISTS (at the Imperial College of Science and Technology, South Kensington, London, S.W.7), at 11 a.m.—Symposium on "The Control of Insects which Attack Stored Foodstuffs".

### Saturday, October 2

ASSOCIATION OF SCIENTIFIC WORKERS (at Essex Hall, Essex Street, Strand, London, W.C.2), at 2.30 p.m.—Conference on "Problems of Freed Europe—The Challenge to the Medical Sciences". Problems of the Occupied Territories: Belgium (Dr. A. Marteau); Czechoslovakia (Dr. V. Kruta); Greece (Dr. A. P. Cawadias); U.S.S.R. (Prof. S. A. Sarkisov); Present Plans for Relief (Prof. J. R. Marrack).

GEOLOGISTS' ASSOCIATION (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. G. S. Sweeting: "Wealden Iron Ore and the History of its Industry".

## APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

HEADS OF THE DEPARTMENTS OF PHYSIOLOGY, MEDICINE, AND SURGERY—The Bursar, Royal Veterinary College and Hospital, at The University, Reading (October 1).

EDUCATIONAL PSYCHOLOGIST (full-time) to work in the Child Guidance Clinic—The Director of Education, Education Office, Town Hall, Bradford (October 2).

EDUCATIONAL PSYCHOLOGIST (full-time) to be responsible for the direction of the Child Guidance Clinic, and A PSYCHIATRIST (part-time)—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (October 2).

CHAIR OF NAVAL ARCHITECTURE—The Acting Secretary of University Court, The University, Glasgow (October 4).

HEADMASTER of the Montgomeryshire County Junior Technical School, Newtown—The Director of Education, County Offices, Newtown, Montgomeryshire (October 9).

AGRICULTURAL EDUCATION OFFICER—The Executive Officer, War Agricultural Executive Committee, County Offices, Aylesbury, Bucks. (October 11).

DIRECTOR OF ROBERT GORDON'S TECHNICAL COLLEGE—The Secretary, Robert Gordon's Technical College, Aberdeen (October 16).

PROFESSOR OF ENGINEERING—The Registrar, University College, Singleton Park, Swansea (November 20).

SCIENCE MASTER TO TEACH CHEMISTRY AND PHYSICS at a leading Boys' School, Jamaica—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Jamaica').

LECTURER IN NATURAL HISTORY—The Principal, Saffron Walden Training College, Saffron Walden.

LECTURER IN NATURE STUDY AND BIOLOGY—The Principal, Dudley Training College, Castle View, Dudley.

DIETITIAN (WOMAN) in the Food Advice Division of the Ministry of Food—The Secretary, Central (Technical and Scientific) Register, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. ON.F.1425).

FOOD ANALYSTS for service in the Army Overseas—Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.1638).

DIRECTOR (ENGINEER with considerable experience in workshop operations, teaching and administration preferred) of the Technical School, Addis Ababa, Ethiopia—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Ethiopia').

ASSISTANT MECHANICAL ENGINEER for mine on Gold Coast engaged on production of essential war material—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1865X).